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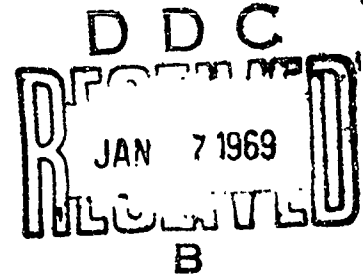
AFAPL-TR-68-88

**DESIGN POINT TURBINE ENGINE
PERFORMANCE PROGRAM**

R. E. WITHERELL, CAPTAIN, USAF

TECHNICAL REPORT AFAPL-TR-68-88

SEPTEMBER 1968



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FOREWORD

This report was prepared in the Components Branch (APTC), Turbine Engine Division, Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, Ohio, under Project 3066, "Gas Turbine Technology," Task 306603, "Advanced Engine Studies," with Charles E. Bentz as Project Engineer.

This report covers work conducted within the Components Branch in the time period between July 1965 and June 1968.

This technical report has been reviewed and is approved.


ERNEST C. SIMPSON
Chief, Turbine Engine Division
Air Force Aero Propulsion Laboratory

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ABSTRACT

This report describes a digital computer program titled CARPET. CARPET is a computer program that calculates parametric turbojet/turbofan engine performance. It can also analyze the performance of a specific engine. The program is written in Fortran IV language and was designed for use on an IBM 7090 Digital Computer. Included in the report are listings of the complete program, various sample input data, and the corresponding output.

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SECTION I
GENERAL DISCUSSION

The CARPET Deck is a computer program that simulates a basic parametric turbojet or turbofan. It can also be used to analyze the performance of a specific engine at discrete operating points if the total airflow is input along with the component characteristics of the engine.

This program is written in FORTRAN IV and requires no special routines or setups. NAMELIST input is used to input data since it retains input values from case to case unless specifically changed in a particular data case. This eliminates continuously inputting parameters that do not change from case to case.

Provisions are included for a title which prints at the top of each page. The output format prints one data case per page within an 8 1/2 x 11 inch area with sufficient room for margins.

Since this program is not a component balancing program, a component performance map is not required.

SECTION II

HOW TO USE CARPET

Time Estimate: Load Time 45 Seconds
 Run Time 0.5 Seconds/Data Case

Line Estimate: 55 Lines Per Data Case

NAMELIST Input: All of the data cards must start in Column 2 or beyond. To start a data case, punch \$INPUT in Columns 2 - 7, then skip a space and continue by punching the input parameter names and the value you wish them to be equal to. Finish that data case by punching a \$ - sign immediately following the last value in that data case. The program then executes that data case and comes back to the data cards for the next case.

The advantage of this input technique is that the program will use values from the preceding point unless specifically changed in the data case that follows. (See Example 1, Setup of CARPET Deck.)

Behind the last data case a card with \$EOF punched in Columns 1 - 4 must be inserted to end the run.

Title Card: Provisions have been included to read a title card which is printed at the top of each output printout. To read a title card, set ITITLE = 1 in the NAMELIST data case to which the title applies. The program then reads Columns 1 - 66 of the first card following that data case as the title. Since the program automatically sets ITITLE = 0 after a title has been read, ITITLE has to be set = 1 only when a new title is desired.

SECTION III

DISCUSSION OF ROUTINES

CARPET: This is the main program and contains all of the normal input and output statements. It also contains all of the logic necessary to simulate a basic parametric turbojet or turbofan. Straight-through programming is used which makes following program logic quite easy.

Subroutine required: DSDRIV

This subroutine is set up to run "Design Derivatives" of a base case. Basically, this routine automatically varies designated engine input parameters by either a \pm percent or a \pm increment. In addition to doing this automatically, this routine prints a subtitle designating the base case and each of the derivative cases including the increment and percent of change for that particular parameter. Printed at the bottom of the output are the ratios $SFC/(SFC_{BASE})$ and $FN/(FN_{BASE})$.

Data setup is as follows:

- a. Set IDEL = 1 in the base case.
- b. Also set ITITLE = 1 and include title card immediately after base case if desired.
- c. Next sequence on data cards the parameters desired to be varied in Col. 1 - 6, the type of variance in Col. 11 - 16 (percent change - PERCNT or increment change - DELTA), and the value of the variance in Col. 21 - 30 (Note: 0.01 = 1%). If a variation in only one direction (+ or -) is desired, follow then with the direction indicator in Col. 31 - 36 (PLUS or MINUS).
- d. After the last parameter varying card, a card must follow with GØØN punched in Col. 1 - 4.

NOTE: The parameters to be varied must appear in the name common PARAM.

Successive data cases will be run with the same design derivatives unless IDEL is set = 0.

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RAM:

Routine for calculating Mil. Spec. 5008B ram recovery.

Calling sequence:

CALL RAM (AM, ETAR)

AM - Flight Mach Number

ETAR - Ram Recovery

COMP:

Routine for calculating compressor or fan exit thermodynamic conditions.

Calling sequence:

CALL COMP (PR, ETA, PI, TI, SI, HI, P ϕ , T ϕ , S ϕ , H ϕ , IER)

PR - Compressor Pressure Ratio

ETA - Compressor Adiabatic Efficiency

PI, P ϕ - Total Pressures Into and Out of Compressor
(Units In Atmospheres)

TI, T ϕ - Total Temperatures Into and Out of Compressor

SI, S ϕ - Entropy

HI, H ϕ - Enthalpy

IER - Error Indicator,

0 = No Error

1 = Error In Entropy Balance

Subroutines Required: THERM ϕ , PR ϕ C ϕ M.

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CØMB:

Routine for calculating combustor and duct-burner thermodynamic exit conditions.

Calling sequence:

CALL COMB (PI, TØ, HI, ETA, DPB, PØ, HØ, SØ, FARØ, HV)

PI, PØ	- Combustor Inlet and Exit Total Pressures (Units In Atmospheres)
TØ	- Combustor Exit Total Temperature
HI, HØ	- Enthalpy
ETA	- Combustion Efficiency (i.e., Applied to Heating Value of Fuel)
DPB	- Total Pressure Drop Across Combustor
SØ	- Entropy At Combustion Exit
FARØ	- Combustor Exit Fuel to Air Ratio
HV	- Heating Value of Fuel (JP-4)

Subroutines Required: THERMØ, PRØCØM, AFQUIR.

TURB:

Routine for calculating turbine thermodynamic exit conditions.

Calling sequence:

CALL TURB (PI, HI, SI, FARI, ETA, DHTI, PØ, TØ, HØ, SØ, IER)

PI, PØ	- Turbine Inlet and Exit Total Pressures (Units In Atmospheres)
--------	---

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HI, H \emptyset - Enthalpy
SI, S \emptyset - Entropy
FARI - Fuel to Air Ratio Into Turbine
ETA - Turbine Adiabatic Efficiency
DHTI - Total Enthalpy Change Across Turbine
Per Pound of Mass Flow Into Turbine
T \emptyset - Turbine Exit Total Temperature
IER - Error Indicator
0 = No Error
1 = Error In Entropy Balance

Subroutines Required: THERM \emptyset , PR \emptyset C \emptyset M.

ABFIRE:

Routine for calculating afterburner thermodynamic exit conditions.

Calling sequence:

CALL ABFIRE (PI, T \emptyset , HI, FARI, ETA, DPB, WGL, WFL, P \emptyset , H \emptyset , S \emptyset ,
FAR \emptyset , WF, WGT, WFT, HV)

PI, P \emptyset - A/B Inlet and Exit Total Pressures
(Units In Atmospheres)
T \emptyset - A/B Exit Total Temperature
HI, H \emptyset - Enthalpy
FARI, FAR \emptyset - A/B Inlet and Exit Fuel to Air Ratios
ETA - A/B Combustion Efficiency (i.e.,
Applied to Heating Value of Fuel)
DPB - Total Pressure Drop Across Afterburner

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WGI, WGT - A/B Inlet and Exit Mass Flows
WFI, WF, WFT - Main Combustor, A/B, and Total
Fuel Flows at A/B Station
S \emptyset - A/B Exit Entropy
HV - Heating Value of Fuel (JP-4)

Subroutines Required: THERM \emptyset , PR \emptyset C \emptyset M, AFQUIR.

NOZ:

Routine for calculating fully expanded, isentropic nozzle conditions.

CALL NOZ (PI, PTI, TTI, STI, FARI, TS \emptyset , HS \emptyset)

PI - Ambient Pressure to Which Mass
Flow Expands (Units In Atmospheres)
PTI - Total Pressure Into Nozzle (Units
In Atmospheres)
TTI - Total Temperature Into Nozzle
STI - Total Entropy Into Nozzle
FARI - Total Fuel to Air Ratio Into Nozzle
TS \emptyset , HS \emptyset - Static Temperature and Enthalpy
Out of Nozzle

Subroutines Required: THERM \emptyset , PR \emptyset C \emptyset M.

ATM \emptyset S:

Routine that simulates 1962 U.S. Standard Atmosphere.

See program listing for calling sequence and definitions of parameters.

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PRØCØM:

Routine that calculates the thermodynamic properties of air and fuel/air mixtures. Range of temperatures is 300 - 4000°R, Range of fuel/air ratio is 0 - 0.067623 (Stoichiometric). Dissociation is not accounted for in this routine.

Calling sequence:

CALL PRØCØM (FAR, T, CS, AK, CP, R, PHI, H)

FAR	- Fuel to Air Ratio
T	- Temperature
CS	- Speed of Sound
AK	- Ratio of Specific Heats (GAMMA)
CP	- Specific Heat At Constant Pressure
R	- Gas Constant
PHI	- ϕ
H	- Enthalpy

THERMØ:

Routine that adds more flexibility in using PRØCØM.

Calling sequence:

CALL THERMØ (P, H, T, S, AM, L, FAR, K)

P	- Pressure In Atmospheres
H	- Enthalpy
T	- Temperature
S	- Entropy
AM	- Molecular Weight of Mass

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- L - Fuel to Air Ratio Indicator
 - 0 = 100% Air
 - 1 = Fuel to Air Ratio = FAR
- FAR - Fuel to Air Ratio
- K - Indicates Solution Desired for T or S
 - 0 = Find H for Input T
 - 1 = Find T for Input H

Subroutine Required: PRØCØM.

AFQUIR:

Air Force Quadratic Interpolation Routine. This routine sets up a quadratic equation and coverages on a solution using Newton's method of solving equations.

See program listing for calling sequence and definitions of parameters.

SECTION IV
INPUT PARAMETERS

<u>SYMBOL</u>	<u>INITIAL VALUE</u>	<u>DESCRIPTION</u>
ALTP	0.0	Altitude
AM	0.0	Flight Mach No.
ETAR	0.0	Ram Recovery = 0.0, calculates Mil Spec., otherwise uses value input
DELTO	0.0	Change in ambient temp from 1962 atmosphere
P2	0.0	Engine face pressure in atmospheres Input only if different from that calculated by ETAR
PRES	1.0	= 1.0 Prints output pressures in atmospheres = 14.696 Prints output pres- sures in lbs/sq inch
WAENG	1.0	Total engine inlet airflow
BPR	0.0	Bypass ratio = duct flow/core flow = 0.0, turbojet (i. e. , no duct)
CV	1.0	Nozzle velocity coefficient = actual/ideal velocity
DPD	0.0	Duct pressure loss, $(P_{24}-P_{26})/P_{24}$
DPFH	0.0	Fan hub pressure loss, $(P_{21H} - P_{21L})/P_{21H}$
DPC	0.0	Inter-Compressor Pressure Loss, $(P_{22L} - P_{22})/P_{22L}$
PRFT	1.0	Fan tip pressure ratio
PRFH	1.0	Fan hub pressure ratio

<u>SYMBOL</u>	<u>INITIAL VALUE</u>	<u>DESCRIPTION</u>
PRLP	1.0	LP compressor pressure ratio
PRC	1.0	HP compressor pressure ratio
LCSL	0.0	LP compressor seal leakage, dumps into duct if turbofan or overboard if turbojet
HCSL	0.0	HP compressor seal leakage, dumps same as LCSL
ETAFT	1.0	Fan tip efficiency
ETAFH	1.0	Fan hub efficiency
ETALP	1.0	LP compressor efficiency
ETAC	1.0	HP compressor efficiency
ETATH	1.0	HP turbine efficiency
ETATL	1.0	LP turbine efficiency
T4	0.0	Combustor discharge tem- perature ($^{\circ}$ R)
T7	0.0	A/ B combustor discharge temperature ($^{\circ}$ R)
T27	0.0	Duct combustor discharge temperature ($^{\circ}$ R)
DPT	0.0	Inter-turbine pressure loss, (P5 - P51)/ P5
DPE	0.0	Tailpipe cold pressure loss, (P56 - P6) / P56
ETAB	1.0	Main combustion efficiency
ETABAB	1.0	A/ B combustion efficiency
ETABFD	1.0	Duct combustion efficiency
DPB	0.0	Main combustor pressure loss, (P3 - P4)/ P3
DPBAB	0.0	A/ B combustor hot pressure loss, (P6 - P7)/ P6
DPBFD	0.0	Duct combustor hot pressure loss, (P26 - P27)/ P26

<u>SYMBOL</u>	<u>INITIAL VALUE</u>	<u>DESCRIPTION</u>
PCBLNZ	0.0	Engine core nozzle cooling flow ratio (to HP compressor inlet flow)
PCBLØW	0.0	LP compressor bleed flow ratio (to LP compressor inlet flow). Lost to cycle.
PCBLØB	0.0	HP compressor bleed flow ratio (to HP compressor inlet flow). Lost to cycle.
PCBLC	0.0	Turbine cooling bleed flow ratio extracted from HP compressor (to HP compressor inlet flow)
PCBLT4	0.0	HP turbine inlet nozzle cooling flow ratio (to HP compressor inlet flow)
PCBLHP	0.0	HP turbine exit cooling flow ratio (to HP compressor inlet flow).
HPEXT	0.0	Horsepower extracted from HP turbine for accessory drive
ITITLE	0	= 1, card following data case will be title card (Col. 1 - 66). Program then sets = 0. = 0, no title card expected. The last title card read will be printed at top of output page
IDEL	0	Design "derivative" indicator. (See discussion of routines: DSDRIV)
IAFTBN	0	= 0, no A/B. = 1, use input T7 Must be set = 1 for each A/B point
IDBURN	0	= 0, no duct burning = 1, use input T27 Must be set = 1 for each duct burning point

SECTION V

STATION DESIGNATION

<u>STATION NUMBER</u>	<u>LOCATION</u>
1	Ambient
2	Inlet exit/ engine face
Core:	
21H	Fan hub discharge
21L	LP compressor inlet if PRLP is greater than 1.0, otherwise HP compressor inlet
22L	LP compressor discharge
22	HP compressor inlet
3	HP compressor discharge
4	Main combustor discharge
41	HP turbine inlet
5	HP turbine discharge before cooling flow has been added
51	LP turbine inlet
55	LP turbine discharge before cooling flow has been added
56	LP turbine discharge including cooling flow effects
6	A/B combustor inlet
7	A/B combustor discharge
8	Engine core nozzle inlet
9	Engine core nozzle discharge (Isentropic expansion to P1)
Duct:	
24	Fan tip discharge

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STATION NUMBER

LOCATION

26

Duct burner inlet

27

Duct burner discharge

28

Duct nozzle inlet

29

Duct nozzle discharge (Isentropic expansion to P1)

SECTION VI

OUTPUT PARAMETERS

Besides most of the input parameters being output, the following parameters are also output.

<u>SYMBOL</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
VA	fps	Flight velocity
CS	fps	Amb'ent speed of sound
PCBLLP	---	LP turbine exit cooling flow ratio (to HP compressor inlet flow)
		NOTE: $PCBLC = PCBLT4 + PCBLHP + PCBLLP$
PRØA	---	Overall core compression ratio, (P3/ P2)
WA--	#/ sec	Airflow rate (number designates location)
BLCSL	#/ sec	LP compressor seal leakage flow rate
BHCSL	#/ sec	HP compressor seal leakage flow rate
P-	Atmospheres or psi	Total pressure (number designates location)
T-	°R	Total temperature (number designates location)
PRTH	---	HP turbine pressure ratio, (P41/ P5)
PRTL	---	LP turbine pressure ratio, (P51/ P55)
BLNØZ	#/ sec	Engine core nozzle cooling flow
V9, V29	fps	Nozzle exit velocities (Isentropic expansion to P1)
HV		Main combustor fuel heating value at T4 for JP-4

<u>SYMBOL</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
HV7, HV27		A/ B and duct burner fuel heating values at their respective temperatures for JP-4
FN/WA	---	Net thrust/ total engine airflow
THG9	---	Core gross thrust per pound total airflow
THG29	---	Duct gross thrust per pound total airflow
ETAP	---	Propulsion Efficiency
H-	BTU/ # Mass	Total enthalpy (number designates location)
TS9, TS29	^o R	Static temperature at nozzle exits
HS9, HS29	BTU/ # Mass	Static enthalpy at nozzle exits
BLØW	#/ sec	LP compressor bleed flow lost to cycle
BLØB	#/ sec	HP compressor bleed flow lost to cycle
BLC	#/ sec	HP compressor bleed flow for turbine cooling
BLT4	#/ sec	HP turbine inlet nozzle cooling flow
BLHP	#/ sec	HP turbine discharge cooling flow
BLLP	#/ sec	LP turbine discharge cooling flow
		NOTE: BLC = BLT4 + BLHP + BLLP
WG-	#/ sec	Mass flow rate (includes fuel flow)
FAR-	---	Fuel flow/ airflow (number designates location)

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<u>SYMBOL</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
WF-	#/sec	Fuel flow rate (number designates combustor location)
ETATHM	---	Thermal Efficiency
ETA ϕ	---	Overall efficiency (i. e. , ETAP x ETATHM)
SFCU	# fuel per hr/ # net thrust	Uninstalled specific fuel consumption
FG	# thrust	Gross thrust
FN	# thrust	Net thrust

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SECTION VII
PROGRAM LISTING

SIBFTC CARPET DECK

```

COMMON /PAKAM/ ETAR ,ETAFT ,ETAFH ,ETALP ,ETAC ,
1 ETAB ,ETATH ,ETATL ,PRFT ,PRFH ,PRLP ,PRC ,
2 DPB ,DPT ,DPE ,DPD ,DPFH ,DPC ,HPEXT ,
3 LCSL ,HCSL ,PCBLNZ,PCBLOW,PCBLOB,PCBLC ,CV
4 T4 ,T7 ,T27 ,ETABAB,ETABFD,DPBAB ,DPBFD
DIMENSION TITLE(11),AWORD(4)
REAL LCSL
DATA AWORD/6HATMOSP,6HHERES ,6HLBS/SQ,6H INCH /
    
```

```

NAMELIST/ INPUT/
1 ALTP ,AM ,ETAR ,DELTO ,P2 ,PRES ,
2 WAENG ,BPR ,CV ,DPD ,DPFH ,DPC ,
3 PRFT ,PRFH ,PRLP ,PRC ,LCSL ,HCSL ,
4 ETAFT ,ETAFH ,ETALP ,ETAC ,ETATH ,ETATL ,
5 T4 ,T7 ,T27 ,DPT ,DPE ,PCBLNZ,
6 ETAB ,ETABAB,ETABFD,PCBLOW,PCBLOB,PCBLC ,
7 DPB ,DPBAB ,DPBFD ,PCBLT4,PCBLHP,HPEXT ,
8 ITITLE,IDEL ,IAFTBN,IOBURN
    
```

```

IP =1
PRES =1.0
WAENG =1.0
CV =1.0
PRFT =1.0
PRFH =1.0
PRLP =1.0
PRC =1.0
ETAFT =1.0
ETAFH =1.0
ETALP =1.0
ETAC =1.0
ETATH =1.0
ETATL =1.0
ETAB =1.0
ETABAB=1.0
ETABFD=1.0
DELTO =0.0
BPR =0.0
DPD =0.0
DPFH =0.0
DPC =0.0
LCSL =0.0
HCSL =0.0
DPT =0.0
DPE =0.0
PCBLNZ=0.0
PCBLOW=0.0
PCBLOB=0.0
PCBLC =0.0
DPB =0.0
DPBAB =0.0
DPBFD =0.0
PCBLT4=0.0
PCBLHP=0.0
HPEXT =0.0
IDEL =0
    
```

```

C *** CONSTANTS
G =32.174049
    
```

```

AJ      =778.26

1  P2      =0.0
   ETAR    =0.0
   IERROR  =0
   IAFTBN  =0
   IOBURN  =0
   JBASE   =0
   READ (5,INPUT)
   IF (ITITLE.GT.0) READ(5,100) (TITLE(I),I=1,11)
   ITITLE  =0
   ALT     =ALTP*2.0855531E07/(2.0855531E07-ALTP)
   CALL ATMOD(ALT,T1,X1,X2,X3,P1,CS,X4,I111)
   T1      =T1+DELTO
   IF (DELTO.GT.0.0) CALL PROCOM(T0.0,T1,CS,X1,X2,X3,X4,X5)

C *** BEGINNING OF INLET
   IF (ETAR.EQ.0.0) CALL RAM(AM,ETAR)
   VA      =AM*CS
   CALL THERMO(P1,H1,T1,S1,X1,0,0.0,0)
   H2      =H1+VA**2/2.*G*AJ)
   P2P     =1.0
   DO 3 J=1,10
   CALL THERMO(P2P,H2,X1,S2P,AMW2P,0,0.0,1)
   IF (ABS(S2P-S1).LE.0.00001*S1) GO TO 5
3  P2P     =P1*EXP(.5035471*AMW2P*(S2P-S1+1.985912/AMW2P*ALOG(P2P/P1)))
   GO TO 500
5  IF (P2.GT.0.0) ETAR =P2/P2P
   P2      =P2P*ETAR
   CALL THERMO(P2,H2,T2,S2,X1,0,0.0,1)
6  IF (IDEL.GT.0) CALL DSDRIV($1)
   IF (BPR.LE.0.0) GO TO 7

C *** BEGINNING OF FAN TIP
   CALL COMP(PRFT,ETAFT,P2,T2,S2,H2,P24,T24,S24,H24,IER)
   IF (IER.GT.0) GO TO 501

C *** BEGINNING OF FAN HUB
   CALL COMP(PRFH,ETAFH,P2,T2,S2,H2,P21H,T21,S21,H21,IER)
   IF (IER.GT.0) GO TO 502
   P21L    =P21H*(1.0-DPFH)
   GO TO 9
7  P24     =0.0
   T24     =0.0
   H24     =0.0
   DPD     =0.0
   PRFT    =1.0
   ETAFT   =1.0
   P21H    =P2
   P21L    =P21H
   T21     =T2
   H21     =H2
   DPFH    =0.0
   PRFH    =1.0
   ETAFH   =1.0
9  IF (PRLP.LE.1.0) GO TO 11

C *** BEGINNING OF LP COMPRESSOR
   CALL THERMO(P21L,H21,T21,S21,X1,0,0.0,0)
   CALL COMP(PRLP,ETALP,P21L,T21,S21,H21,P22L,T22,S22,H22,IER)
   IF (IER.GT.0) GO TO 503

```

```

      GO TO 13
11  P22L =P21L
     T22  =T21
     H22  =H21
-----
     DPC  =0.0
     PRLP =1.0
     ETALP=1.0
     LCSL =0.0
13  IF(PRC .LE.1.0) GO TO 15
C *** BEGINNING OF HP COMPRESSOR
     P22  =P22L*(1.0-DPC)
     CALL THERMU(P22,H22,T22,S22,X1,0,0.0,0)
     CALL CUMP(PRC,ETAC,P22,T22,S22,H22,P3,T3,S3,H3,IER)
     IF(IER.GT.0) GO TO 504
     GO TO 17
15  P22  =P22L
     P3   =P22
     T3   =T22
     H3   =H22
     DPC  =0.0
     PRC  =1.0
-----
     ETAC =1.0
     HCSL =0.0
17  PROA =PRC*PRLP*(1.0-DPC)*PRFH*(1.0-DPFH)
C *** AIR FLOWS
     WA2  =1.0
-----
     WA21 =WA2/(BPR+1.0)
     WA24 =WA2-WA21
     WA22 =WA21*(1.0-LCSL-PCBLOW)
     WA3  =WA22*(1.0-HCSL-PCBLUB-PCBLC-PCBLN2)
C *** BLEED FLOWS
-----
     BLOW =PCBLOW*WA21
     BLLCSL=LCSL *WA22
     BLHCSL=HCSL *WA22
     BLUB  =PCBLUB*WA22
     IF((PCBLT4+PCBLHP).GT.PCBLC) PCBLHP=PCBLC-PCBLT4
     PCBLLP=PCBLC-PCBLT4-PCBLHP
-----
     BLLC  =PCBLC *WA22
     BLT4  =PCBLT4*WA22
     BLHP  =PCBLHP*WA22
     BLLP  =PCBLLP*WA22
     BLNOZ =PCBLN2*WA22
C *** BEGINNING OF MAIN COMBUSTOR
     CALL COMB(P3,T4,H3,ETAB,DPB,P4,H4,S4,FAR4,HV)
     WF4  =FAR4*WA3
     WG4  =WA3+WF4
C *** BEGINNING OF HP TURBINE
-----
     P41  =P4
     WG41 =WG4+BLT4
     FAR41 =WF4/(WA3+BLT4)
     H41  =(H4*WG4+H3*BLT4)/WG41
     CALL THERMO(P41,H41,T41,S41,X1,1,FAR41,1)
     HPBTU =0.7068*HPEXT/(WAENG*WG41)
     DHTH  =(HPBTU+(H3-H22)*WA22)/WG41
     CALL TURB(P41,H41,S41,FAR41,ETATH,DHTH,P5,T5,H5,S5,IER)
     IF(IER.GT.0) GO TO 505

```

```

PRTH =P41/P5
P51 =P5*(1.0-DPT)
WG51 =WG41+BLHP
H51 =(H5*WG41+H3*BLHP)/WG51
-----
FAR51 =WF4/(WG51-WF4)
CALL THERMO(P51,H51,T51,S51,X1,1,FAR51,1)

C *** BEGINNING OF LP TURBINE
DHTL =((H24-H2)*WA24+(H21-H2)*WA21+(H22-H21)*WA21)/WG51
CALL TURB(P51,H51,S51,FAR51,FIATL,DHTL,P55,T55,H55,S55,IFW)
-----
IF(IER.GT.0) GO TO 506
PRTL =P51/P55
P56 =P55
WG56 =WG51+BLLP
H56 =(H55*WG51+H3*BLLP)/WG56
FAR56 =WF4/(WG56-WF4)
-----
CALL THERMO(P56,H56,T56,S56,X1,1,FAR56,1)

C *** BEGINNING OF TAILPIPE AND A/R
P6 =P56*(1.0-DPE)
T6 =T56
H6 =H56
-----
IF(IAFTBN.GT.0) GO TO 19
WF7 =0.0
T7 =T6
P7 =P6
H7 =H6
FAR7 =FAR56
-----
WG7 =WG56
WFTGG =WF4
GO TO 21
19 CALL ABFIRE(P6,T7,H6,FAR56,FTABAB,DPBAB,WG56,WF4,P7,H7,S7,
1 FAR7,WF7,WG7,WFTGG,HV7)

-----
C *** BEGINNING OF GG NOZZLE
21 WGR =WG7+BLNOZ
H8 =(H7*WG7+H3*BLNOZ)/WGR
FAR8 =WFTGG/(WGR-WFTGG)
P8 =P7
CALL THERMO(P8,H8,T8,S8,X1,1,FAR8,1)
-----
IF(P8.LT.P1) GO TO 507
CALL NOZ(P1,P8,T8,S8,FAR8,TS9,HS9)
IF(TS9.LE.T1) GO TO 508
V9 =CV*223.733*SQRT(H8-HS9)
IF(BPR.LE.0.0) GO TO 23

-----
C *** BEGINNING OF DUCT AND O/B
P26 =P24*(1.0-DPD)
WA26 =WA24+LCSL*WA21+HCSL*WA22
H26 =(H24*WA24+H21*LCSL*WA21+H22*HCSL*WA22)/WA26
CALL THERMO(P26,H26,T26,S26,X1,0,0,1)
IF(IDBURN.GT.0) GO TO 25
-----
FAR27 =0.0
WF27 =0.0
P27 =P26
T27 =T26
H27 =H26
S27 =S26
-----
GO TO 27
23 P26 =0.0
T26 =0.0

```

```

M26 =0.0
P27 =0.0
T27 =0.0
H27 =0.0
-----
P28 =0.0
T28 =0.0
H28 =0.0
TS29 =0.0
HS29 =0.0
V29 =0.0
-----
XMU =0.0
WF27 =0.0
GO TO 29
25 CALL COM8(P26,T27,H26,ETABFD,DPBFD,P27,H27,S27,FAR27,HV27)
WF27 =FAR27*WA26
27 WG27 =WA26+WF27
WG28 =WG27
P28 =P27
T28 =T27
H28 =H27
S28 =S27
FAR28 =FAR27
-----
CALL NOZ(P1,P28,T28,S28,FAR28,TS29,HS29)
V29 =CV*223.733*SORT(H28-HS29)

C *** PERFORMANCE CALCULATIONS
XMU =VA/V29
29 XNU =VA/V9
-----
THG29 =V29*WG28/G
THG9 =V9*WG8/G
THGU =THG9+THG29
FNU =THGU-VA*WA2/G
FNQWA =FNU/WA2
WFTOT =WFTGG+WF27
-----
SFCU =WFTOT*3600./FNU
FG =THGU*WAENG
FN =FNQWA*WAENG
ETAN =1./XNU*(1.+FAR8-XNU)+BPR/XMU*(1.+FAR28-XMU)
ETAD =ETAN+0.5*((1.+FAR8)/XNU**2*(1.-XNU)**2+BPR*(1.+FAR28)
1 /XMU**2*(1.-XMU)**2)
-----
ETAP =ETAN/ETAD
ETATHM=ETAD*VA**2/(G*AJ*(FAR8*(HV+VA**2/(2.*G*AJ))+
1 BPR*FAR28*(HV27+VA**2/(2.*G*AJ))))
ETAO =ETAP*ETATHM

31 XWA24 =WA24 *WAENG
XWA26 =WA26 *WAENG
XWA21 =WA21 *WAENG
XWA22 =WA22 *WAENG
XWA3 =WA3 *WAENG
XBLOW =BLOW *WAENG
XBLCSL=BLLCSL*WAENG
-----
XBHCSL=BLHCSL*WAENG
XBLOB =BLOB *WAENG
XBLNOZ=BLNOZ *WAENG
XBLC =BLC *WAENG
XBLT4 =BLT4 *WAENG
XBLHP =BLHP *WAENG
-----
XBLLP =BLLP *WAENG
XWG4 =WG4 *WAENG
XWG41 =WG41 *WAENG

```

```

XWG51 =WG51 *WAENG
XWG56 =WG56 *WAENG
XWG7  =WG7  *WAENG
XWG8  =WG8  *WAENG
XWG27 =WG27 *WAENG
XWG28 =WG28 *WAENG
XWF4  =WF4  *WAENG
XWF7  =WF7  *WAENG
XWF27 =WF27 *WAENG
XWFTGG=WFTGG *WAENG
XP1   =P1   *PRES
XP2   =P2   *PRES
XP21H =P21H *PRES
XP21L =P21L *PRES
XP22L =P22L *PRES
XP22  =P22  *PRES
XP3   =P3   *PRES
XP4   =P4   *PRES
XP41  =P41  *PRES
XP5   =P5   *PRES
XP51  =P51  *PRES
XP55  =P55  *PRES
XP56  =P56  *PRES
XP6   =P6   *PRES
XP7   =P7   *PRES
XP8   =P8   *PRES
XP24  =P24  *PRES
XP26  =P26  *PRES
XP27  =P27  *PRES
XP28  =P28  *PRES
IF(JRASF.LE.0) SFCB =SFCB
IF(JRASF.LE.0) FNB  =FN
PCBSFC=SFCB/SFCB
PCBFN  =FN/FNB

```

```

WRITE(6,2000) (TITLE(I),I=1,11)
IF(IDEL.GT.0) CALL DSDOUT
IF(IERROR.GT.0) WRITE(6,1990)
WRITE(6,2001) ALTP ,AM ,VA ,DELTO ,ETAR ,CS
WRITE(6,2002) HPEXT ,LCSL ,HCSL ,PCBL0W,PCBL0H,PCBLNZ
WRITE(6,2003) PCBLC ,PCBLT4,PCRLHP,PCBLLP,PR0A ,PRK ,WAFNG
WRITE(6,2004) PRFT ,ETAFT ,XWA24 ,XWA26 ,
1 PRFH ,ETAFH ,XWA21 ,XBLCSL
WRITE(6,2005) PRLP ,ETALP ,XWA22 ,XRHCSL,PRC ,ETAC ,XWA3
IF(PRES.GT.1.0) IP=3
WRITE(6,2006) DPD ,DPFH ,DPC ,AWORD(IP) ,AWORD(IP+1)
WRITE(6,2007) XP1 ,T1 ,H1 ,XP2 ,T2 ,H2
WRITE(6,2008) XP21H ,T21 ,H21 ,XP21L
WRITE(6,2009) XP22L ,T22 ,H22 ,XBL0W ,XP22 ,XBL0B
WRITE(6,2010) XP3 ,T3 ,H3 ,XBLC ,
1 XP4 ,T4 ,H4 ,XWG4
WRITE(6,2011) DPB ,ETAB ,FAR4 ,XWF4 ,
1 XP41 ,T41 ,H41 ,XBLT4
WRITE(6,2012) XP5 ,T5 ,H5 ,XWG41 ,PRTH ,ETATH ,DPT
WRITE(6,2013) XP51 ,T51 ,H51 ,XBLHP ,
1 XP55 ,T55 ,H55 ,XWG51
WRITE(6,2014) PKTL ,ETATL ,DPF ,XP56 ,T56 ,H56 ,XBLLP
WRITE(6,2015) XP6 ,T6 ,H6 ,XWG56 ,
1 XP7 ,T7 ,H7 ,XWG7
IF(IAFTBN.GT.0) WRITE(6,2016) ETABAB,DPBAB ,XWF7
WRITE(6,2017) XP8 ,T8 ,H8 ,XBLN0Z,

```

```

1          V9      ,TS9  ,MS9  ,XWG8
WRITE(6,2018) XP24 ,T24  ,M24  ,XP26 ,T26  ,M26
WRITE(6,2019) XP27 ,T27  ,M27  ,XWG27
IF (IDURN.GT.0) WRITE(6,2020) ETABFD,DPRFD ,XWF27
WRITE(6,2021) XP28 ,T28  ,M28  ,XWG28 ,V29  ,TS29 ,MS29
WRITE(6,2022) FAR41 ,FAR51 ,FAR56 ,FAR7  ,FAR8  ,FAR27
WRITE(6,2023) HV    ,HV7  ,HV27 ,CV    ,V9   ,V29
WRITE(6,2024) FNGWA ,THG9  ,THG29 ,ETAP  ,ETATHM,ETAO
WRITE(6,2025) SFCU  ,FG    ,FN
IF (IDEL.GT.0) WRITE(6,2026) PCBSEC,PCBFN
WRITE(6,2050)
IF (IDEL.GT.0) JBASE =1
IF (IDEL.GT.0) GO TO 6
GO TO 1

```

C *** ERROR STATEMENTS

```

500 WRITE(6,1500) P1,S1,P2P,S2P
GO TO 600
501 WRITE(6,1501) P2,T2,PRFT,ETAFT
GO TO 600
502 WRITE(6,1502) P2,T2,PRFH,ETAFH
GO TO 600
503 WRITE(6,1503) P21L,T21,PRLP,ETALP
GO TO 600
504 WRITE(6,1504) P22,T22,PRC,ETAC
GO TO 600
505 WRITE(6,1505) P41,H41,DHTH,ETATH
GO TO 600
506 WRITE(6,1506) P51,H51,DHTL,ETATL
GO TO 600
507 WRITE(6,1507) P8,P1
GO TO 600
508 WRITE(6,1508) TS9,T1
600 IFERROR=1
GO TO 31

```

```

100 FORMAT(11A6)
1500 FORMAT(1H1,25HINLET DID NOT CONVERGE - ,4E14.6)
1501 FORMAT(1H1,16HFAN TIP ERROR - ,4E14.6)
1502 FORMAT(1H1,16HFAN HUB ERROR - ,4E14.6)
1503 FORMAT(1H1,16HLO COMP ERROR - ,4E14.6)
1504 FORMAT(1H1,16HHI COMP ERROR - ,4E14.6)
1505 FORMAT(1H1,16HHI TURB ERROR - ,4E14.6)
1506 FORMAT(1H1,16HLO TURB ERROR - ,4E14.6)
1507 FORMAT(1H1,23HGG NOZZLE PRES ERROR - ,2E14.6)
1508 FORMAT(1H1,23HGG NOZZLE TEMP ERROR - ,2E14.6)
1990 FORMAT(1H0,35X,37H*** ERROR IN FOLLOWING POINT. ***)

```

```

2000 FORMAT(1H1/1H ,20X,11A6)
2001 FORMAT(1H0,29X,
1 7HALTP =, F8.0,9H AM =, F8.4,9H VA =, F8.2,/1H ,29X,
2 7HDELTO =, F8.2,9H ETAR =, F8.5,9H CS =, F8.2)
2002 FORMAT(1H0,20X,
1 7HHPEXT =, F8.2,9H LCSL =, F8.5,9H HCSSL =, F8.5,/1H ,20X,
2 7HPCBLOW=, F8.5,9H PCBLOP=, F8.5,9H PCBLN7=, F8.5)
2003 FORMAT(1H ,20X,
A 7HPCBLC =, F8.5,9H PCBLT4=, F8.5,9H PCBLHP=, F8.5,
1 3X,7HPCBLLP=, F8.5,/1H ,20X,
2 7HPRQA =, F8.3,9H BPR =, F8.3,9H WAFNG =, F8.2)
2004 FORMAT(1H0,20X,
A 7HPRFT =, F8.4,9H ETAFT =, F8.5,9H WA24 =, F8.3,

```


1 3X,7HWA26 =, F8.3,/1H ,20X,
 2 7HPRFH =, F8.4,9H ETAFH =, F8.5,9H WA21 =, F8.3,
 3 3X,7HBLLCSL=, F8.3)
 2005 FORMAT(1H ,20X,
 A 7HPRLP =, F8.4,9H ETALP =, F8.5,9H WA22 =, F8.3,
 1 3X,7HBLHC SL=, F8.3,/1H ,20X,
 2 7HPRC =, F8.4,9H ETAC =, F8.5,9H WA3 =, F8.3)
 2006 FORMAT(1H ,20X,
 1 7HDPD =, F8.5,9H DPFH =, F8.5,9H DPC =, F8.5,/1H ,20X,
 2 13HPRESURES IN ,2A6)
 2007 FORMAT(1H ,20X,
 1 7HP1 =, F8.3,9H T1 =, F8.2,9H H1 =, F8.2,/1H ,20X,
 2 7HP2 =, F8.3,9H T2 =, F8.2,9H H2 =, F8.2)
 2008 FORMAT(1H ,20X,
 1 7HP21H =, F8.3,9H T21 =, F8.2,9H H21 =, F8.2,/1H ,20X,
 2 7HP21L =, F8.3)
 2009 FORMAT(1H ,20X,
 A 7HP22L =, F8.3,9H T22 =, F8.2,9H H22 =, F8.2,
 1 3X,7HBLOW =, F8.3,/1H ,20X,
 2 7HP22 =, F8.3,35X ,9H BLOW =, F8.3)
 2010 FORMAT(1H ,20X,
 A 7HP3 =, F8.3,9H T3 =, F8.2,9H H3 =, F8.2,
 1 3X,7HBLC =, F8.3,/1H ,20X,
 2 7HP4 =, F8.3,9H T4 =, F8.2,9H H4 =, F8.2,
 3 3X,7HWG4 =, F8.3)
 2011 FORMAT(1H ,20X,
 A 7HDPB =, F8.4,9H ETAB =, F8.5,9H FAR4 =, F8.5,
 1 3X,7HWF4 =, F8.4,/1H ,20X,
 2 7HP41 =, F8.3,9H Y41 =, F8.2,9H H41 =, F8.2,
 3 3X,7HBLT4 =, F8.3)
 2012 FORMAT(1H ,20X,
 A 7HP5 =, F8.3,9H T5 =, F8.2,9H H5 =, F8.2,
 1 3X,7HWG41 =, F8.3,/1H ,20X,
 2 7HPRTH =, F8.4,9H ETATH =, F8.5,9H DPT =, F8.5)
 2013 FORMAT(1H ,20X,
 A 7HP51 =, F8.3,9H T51 =, F8.2,9H H51 =, F8.2,
 1 3X,7HBLHP =, F8.3,/1H ,20X,
 2 7HP55 =, F8.3,9H T55 =, F8.2,9H H55 =, F8.2,
 3 3X,7HWG51 =, F8.3)
 2014 FORMAT(1H ,20X,
 1 7HPRTL =, F8.4,9H ETATL =, F8.5,9H DPE =, F8.5,/1H ,20X,
 2 7HP56 =, F8.3,9H T56 =, F8.2,9H H56 =, F8.2,
 3 3X,7HBLLP =, F8.3)
 2015 FORMAT(1H ,20X,
 A 7HP6 =, F8.3,9H T6 =, F8.2,9H H6 =, F8.2,
 1 3X,7HWG56 =, F8.3,/1H ,20X,
 2 7HP7 =, F8.3,9H Y7 =, F8.2,9H H7 =, F8.2,
 3 3X,7HWG7 =, F8.3)
 2016 FORMAT(1H ,21X,
 1 13H* * A/B * *,3X,7HETABAB=, F8.5,9H DPBAB =, F8.5,
 2 3X,7HWF7 =, F8.4)
 2017 FORMAT(1H ,20X,
 A 7HP8 =, F8.3,9H T8 =, F8.2,9H H8 =, F8.2,
 1 3X,7HBLNOL =, F8.3,/1H ,20X,
 2 7HV9 =, F8.2,9H TS9 =, F8.2,9H HS9 =, F8.2,
 3 3X,7HWG8 =, F8.3)
 2018 FORMAT(1H0,20X,
 1 7HP24 =, F8.3,9H T24 =, F8.2,9H H24 =, F8.2,/1H ,20X,
 2 7HP26 =, F8.3,9H T26 =, F8.2,9H H26 =, F8.2)
 2019 FORMAT(1H ,20X,
 1 7HP27 =, F8.3,9H T27 =, F8.2,9H H27 =, F8.2,

```

2 3X,7HWG27 =, F8.3)
2020 FORMAT(1H ,21X,
1 13H* * D/B * *,3X,7HETABFD=, F8.5,9H DPBFD =, F8.5,
2 3X,7HWF27 =, F8.4)
-----
2021 FORMAT(1H ,20X,
A 7HP28 =, F8.3,9H T28 =, F8.2,9H H28 =, F8.2,
1 3X,7HWG28 =, F8.3,71H ,20X,
2 7HV29 =, F8.2,9H TS29 =, F8.2,9H HS29 =, F8.2)
2022 FORMAT(1H0,20X,
1 7HFAR41 =, F8.5,9H FAR51 =, F8.5,9H FAR56 =, F8.5,71H ,20X,
2 7HFAR7 =, F8.5,9H FAR8 =, F8.5,9H FAR27 =, F8.5)
2023 FORMAT(1H ,20X,
1 7HHV =, F8.1,9H HV7 =, F8.1,9H HV27 =, F8.1,71H ,20X,
2 7HCV =, F8.5,9H V9 =, F8.2,9H V29 =, F8.2)
2024 FORMAT(1H0,29X,
1 7HFN/WA =, F8.3,9H THG9 =, F8.3,9H THG29 =, F8.3,71H ,29X,
2 7HETAP =, F8.5,9H ETATHM=, F8.5,9H ETAO =, F8.5)
2025 FORMAT(1H ,29X,
1 7H-SFCU =, F8.5,9H FG =, F8.1,9H FN =, F8.1)
2026 FORMAT(1H ,29X,
1 10HSFC/SFCB =F8.5,15X,8HFN/FN8 =F8.5)
2050 FORMAT(1H0,26X,
1 55HTHIS PROGRAM WAS DEVELOPED BY FUTILITY AIRCRAFT, UNINC.,/,
2 1H ,20X,17HCOMPONENTS BRANCH,27X,
3 23HTURBINE ENGINE DIVISION,71H ,33X,
4 41HU.S. AIR FORCE AERO PROPULSION LABORATORY)
-----
END

```

```

$IBFTC DSDRIV DECK
SUBROUTINE DSDRIV(*)
DIMENSION VAR(33),PAR(33),ISAVE(33),CSAVE(33),DSAVE(33),PSAVE(33),
1 SSAVE(33)
COMMON /PARAM/ ETAR ,ETAFT ,ETAFH ,ETALP ,ETAC ,
1 ETAB ,ETATH ,ETATL ,PRFT ,PRFH ,PRLP ,PRC ,
2 DPB ,DPT ,DPE ,DPD ,DPFH ,DPC ,HPEXT ,
3 LCSL ,HCSL ,PCBLNZ ,PCBLOW ,PCBLOB ,PCBLC ,CV ,
4 T4 ,T7 ,T27 ,ETABAB ,ETABFD ,DPBAB ,OPBFD
DATA VAR/
1 6HETAR ,6HETAFT ,6HETAFH ,6HETALP ,6HETAC ,
2 6HETAB ,6HETATH ,6HETATL ,6HPRFT ,6HPRFH ,6HPRLP ,6HPRC ,
3 6HDPB ,6HDPT ,6HDPE ,6HDPD ,6HDPFH ,6HDPC ,6HHPEXT ,
4 6HLCSL ,6HHCSL ,6HPCBLNZ ,6HPCBLOW ,6HPCBLOB ,6HPCBLC ,6HCV ,
5 6HT4 ,6HT7 ,6HT27 ,6HETABAB ,6HETABFD ,6HDPBAB ,6HDPBFD /
DATA IBASE,NUM,WORD,GOON,HOWD/O,0,6H ,6HGOON ,6HDELTA /
DATA AMINUS,PLUS/6HMINUS ,6HPLUS /
EQUIVALENCE (PAR,ETAR)
IF (IBASE.GT.0) GO TO 1
IBASE=1
NUM=0
RETURN
1 IF (WORD.EQ.GOON) GO TO 6
IF (IBASE.GT.1) GO TO 4
IBASE=2
READ(5,100) WORD,HOW,COW,SOW
IF (WORD.EQ.GOON) GO TO 7
DO 2 I=1,33
II=1
2 IF (WORD.EQ.VAR(I)) GO TO 3
WRITE(6,101) WORD
STOP
3 IF (HOW.EQ.HOWD) DELTA=COW
IF (HOW.NE.HOWD) DELTA=COW*PAR(II)
PERCNT=100.*DELTA/PAR(II)
NUM=NUM+1
ISAVE(NUM)=II
CSAVE(NUM)=COW
DSAVE(NUM)=DELTA
PSAVE(NUM)=PERCNT
SSAVE(NUM)=SOW
PARSAV=PAR(II)
IF (SOW.EQ.AMINUS) GO TO 4
PAR(II)=PARSAV+DELTA
RETURN
4 IF (IBASE.GT.2 .OR. SOW.EQ.PLUS) GO TO 5
IBASE=3
PAR(II)=PARSAV-DELTA
RETURN
5 PAR(II)=PARSAV
IBASE=1
GO TO 1
6 IF (IBASE.GT.1) GO TO 4
IBASE=2
NUM=NUM+1
IF (NUM.GT.NUM) GO TO 7
II =ISAVE(NUM)
COW =CSAVE(NUM)
DELTA =DSAVE(NUM)
PERCNT=PSAVE(NUM)
SOW =SSAVE(NUM)

```

```

PARSAV=PAR(II)
IF(SOW.EQ.AMINUS) GO TO 4
PAR(II)=PARSAV+DELTA
RETURN
-----
7  IBASE=0
   RETURN
   ENTRY DSDOUT
   IF(IBASE.EQ.1) WRITE(6,200)
   IF(IBASE.EQ.2) WRITE(6,201) VAR(II),PERCNT,DELTA
   IF(IBASE.EQ.3) WRITE(6,202) VAR(II),PERCNT,DELTA
   RETURN
-----
100 FORMAT(A6,4X,A6,4X,E10.0,A6)
101 FORMAT(1H0,/,1H0,A6,32H NOT IN COMMON, POINT TERMINATED)
200 FORMAT(1H ,48X,10HBASE POINT)
201 1  FORMAT(1H ,22X,21HBASE POINT - VARYING ,A6,5H BY +,
      F6.1,17H PERCENT (DELTA =,F7.3,1H))
-----
202 1  FORMAT(1H ,22X,21HBASE POINT - VARYING ,A6,5H BY -,
      F6.1,17H PERCENT (DELTA =,F7.3,1H))
   END

```

```

$IBFTC RAM    DECK
SUBROUTINE RAM(AX,ETX)
ETX=1.0
-----
IF(AX.GT.1.0) ETX=1.0-0.075*((AX-1.0)**1.35)
IF(AX.GT.5.0) ETX=800.0/((AX**4)+935.0)
RETURN
END

```

```

$IBFTC COMP    DECK
SUBROUTINE COMP(PRC,FTAC,PIN,TIN,SIN,HIN,POUT,TOUT,SOUT,HOUT,IFR)
POUT=PRC*PIN
-----
TOUTP=(PRC**2.28572)*TIN
DO 1 J=1,10
CALL THERMO(POUT,HOUTP,TOUTP,SOUTP,X,0,X,0)
IF(ABS(SOUTP-SIN).LT.0.0001*SIN) GO TO 2
1  TOUTP=TOUTP/EXP((SOUTP-SIN)**4.)
   IER=1
   RETURN
-----
2  HOUT=((HOUTP-HIN)/ETAC)+HIN
   CALL THERMO(POUT,HOUT,TOUT,SOUT,X,0,X,1)
   IER=0
   RETURN
END

```

```

SIBFTC COMB DECK
SUBROUTINE COMB(PIN,TOUT,HIN,ETAB,DPB,POUT,HOUT,SOUT,FAROUT,HV)
DIMENSION X(9)
X(2)=0.0
X(3)=0.0
PDUT=PIN*(1.0-DPB)
HV=((((((-0.4594317E-19*TOUT)-.2034116E-15)*TOUT+.2783643E-11)*TOUT
1 +.2051501E-07)*TOUT-.2453116E-03)*TOUT-.9433296E-01)*TOUT+
2 .1845537E+05
CALL THERMO(POUT,HOUT,TOUT,X1,X2,0,0,0)
FAROUT=(HOUT-HIN)/(HV*ETAB)
FARS=FAROUT
CALL THERMO(POUT,HOUT,TOUT,SOUT,X1,1,FAROUT,0)
1 DELFAR=(FARS-FAROUT)/FAROUT
CALL AFQUIR(X(1),TOUT,DELFAR,0.,15.,.0001,.95,TNEW,ICON)
GO TO (2,4,3),ICON
2 TOUT=TNEW
HV=((((((-0.4594317E-19*TOUT)-.2034116E-15)*TOUT+.2783643E-11)*TOUT
1 +.2051501E-07)*TOUT-.2453116E-03)*TOUT-.9433296E-01)*TOUT+
2 .1845537E+05
CALL THERMO(POUT,HOUT,TOUT,X1,X2,0,0,0)
FARS=(HOUT-HIN)/(HV*ETAB)
GO TO 1
3 WRITE(6,100)
4 CALL THERMO(POUT,HOUT,TOUT,SOUT,X1,1,FAROUT,0)
RETURN
100 FORMAT(38H STOICHIOMETRIC TEMP WILL NOT CONVERGE)
END

```

```

SIBFTC TURB DECK
SUBROUTINE TURB(PIN,HIN,SIN,FARIN,FTATIN,DHTIN,POUT,TOUT,
1 HOUT,SOUT,IER)
HOUT=HIN-DHTIN
HOUTP=HIN-DHTIN/ETATIN
POUT=PIN*.5
DO 1 J=1,10
CALL THERMO(POUT,HOUTP,TOUT,SOUT,AMOUT,1,FARIN,1)
IF(ABS(SOUT-SIN).LT.0.0001*SIN) GO TO 2
1 POUT=PIN*EXP((.5035471*AMOUT)*((SOUT-SIN)+(1.985912/AMOUT)
1*ALOG(POUT/PIN)))
IER=1
RETURN
2 CALL THERMO(POUT,HOUT,TOUT,SOUT,X,1,FARIN,1)
IER=0
RETURN
END

```

```

$IBFTC ABFIRE DECK
SUBROUTINE ABFIRE(PIN, TOUT, HIN, FARIN, ETAB, DPB, WGIN, WFIN, POUT, HOUT,
1 SOUT, FAROUT, WF, WGTOT, WFTOT, HV)
DIMENSION X(9)
X(2)=0.0
X(3)=0.0
POUT=PIN*(1.0-DPB)
CALL THERMO(POUT, HOUTA, TOUT, X1, X2, 1, FARIN, 0)
HV=((((((-0.4594317E-19*TOUT)-.2034116E-15)*TOUT+.2783643E-11)*TOUT
1 +.2051501E-07)*TOUT-.2453116E-03)*TOUT-.9433296E-01)*TOUT+
2 .1845537E+05
FARX=(HOUTA-HIN)/(HV*ETAB)
WF=FARX*WGIN
WGTOT=WF+WGIN
WFTOT=WF+WFIN
FAROUT=WFTOT/(WGIN-WFIN)
FARS=FAROUT
CALL THERMO(POUT, HOUT, TOUT, SOUT, X1, 1, FAROUT, 0)
1 DELFAR=(FARS-FAROUT)/FAROUT
CALL AFQUIR(X(1), TOUT, DELFAR, 0., 15., .0001, 0.95, TNEW, ICON)
GO TO (2, 4, 3), ICON
2 TOUT=TNEW
HV=((((((-0.4594317E-19*TOUT)-.2034116E-15)*TOUT+.2783643E-11)*TOUT
1 +.2051501E-07)*TOUT-.2453116E-03)*TOUT-.9433296E-01)*TOUT+
2 .1845537E+05
CALL THERMO(POUT, HOUTA, TOUT, X1, X2, 0, 0., 0)
FARX=(HOUTA-HIN)/(HV*ETAB)
WF=FARX*WGIN
WGTOT=WF+WGIN
WFTOT=WF+WFIN
FARS=WFTOT/(WGIN-WFIN)
GO TO 1
3 WRITE(6, 100)
4 CALL THERMO(POUT, HOUT, TOUT, SOUT, X1, 1, FAROUT, 0)
RETURN
100 FORMAT(47H ABFIRE - STOICHIOMETRIC TEMP WILL NOT CONVERGE)
END

```

```

$IBFTC NOZ DECK
SUBROUTINE NOZ(P1, PTIN, TTIN, STIN, FARIN, TSOUT, HSOUT)
TSOUT=TTIN*((P1/PTIN)**.206)
DO J=1, 10
IF(TSOUT.LT.300.0) TSOUT=300.0
CALL THERMO(P1, HSOUT, TSOUT, SSOUT, Z, 1, FARIN, 0)
IF(ABS(SSOUT-STIN).LT.0.0001*STIN) GO TO 2
1 TSOUT=TSOUT/(EXP((SSOUT-STIN)*4.))
WRITE(6, 100) P1, TTIN, TSOUT
2 RETURN
100 FORMAT(29H NOZZLE DID NOT CONVERGE, P1=,E15.6, 7H, TTIN=,E15.6,
1 8H, TSOUT=,E15.6)
END

```

```

$IBFTC ATM062 DECK
SUBROUTINE ATMOS (ZFT, TM, SIGMA, RHO, THETA, DELTA, CA, AMU, K)
C THIS IS A SUBROUTINE TO COMPUTE CERTAIN ELEMENTS OF THE 1962
C U.S. STANDARD ATMOSPHERE UP TO 90 KILOMETERS.
C CALLING SEQUENCE...
C
C CALL ATMOS (ZFT, TM, SIGMA, RHO, THETA, DELTA, CA, AMU, K)
C ZFT = GEOMETRIC ALTITUDE (FEET)
C TM = MOLECULAR SCALE TEMPERATURE (DEGREES RANKINE)
C SIGMA = RATIO OF DENSITY TO THAT AT SEA LEVEL
C RHO = DENSITY (LB-SEC**2-FT**(-4) OR SLUGS-FT**3)
C THETA = RATIO OF TEMPERATURE TO THAT AT SEA LEVEL
C DELTA = RATIO OF PRESSURE TO THAT AT SEA LEVEL
C CA = SPEED OF SOUND (FT/SEC)
C AMU = VISCOSITY COEFFICIENT (LB-SEC/FT**2)
C
C K = 1 NORMAL
C     = 2 ALTITUDE LESS THAN -5000 METERS OR GREATER THAN 90 KM
C     = 3 FLOATING POINT OVERFLOW
C
C ALL DATA AND FUNDAMENTAL CONSTANTS ARE IN THE METRIC SYSTEM AS
C THESE QUANTITIES ARE DEFINED AS EXACT IN THIS SYSTEM.
C
C THE RADIUS OF THE EARTH (REFT59) IS THE VALUE ASSOCIATED WITH THE
C 1959 ARDC ATMOSPHERE SO THAT PROGRAMS CURRENTLY USING THE LIBRARY
C ROUTINE WILL NOT REQUIRE ALTERATION TO USE THIS ROUTINE.
C DIMENSION HB(10),TMB(10),DELTAB(10),ALM(10)
C DATA(HB(I), TMB(I), DELTAB(I), ALM(I),I=1,10)/
A -5.0, 320.65, 1.75363E 00, -6.5,
B 0.0, 288.15, 1.00000E 00, -6.5,
C 11.0, 216.65, 2.23361E-01, 0.0,
D 20.0, 216.65, 5.40328E-02, 1.0,
E 32.0, 228.65, 8.56663E-03, 2.8,
F 47.0, 270.65, 1.09455E-03, 0.0,
G 52.0, 270.65, 5.82289E-04, -2.0,
H 61.0, 252.65, 1.79718E-04, -4.0,
I 79.0, 180.65, 1.0241 E-05, 0.0,
J 88.743, 180.65, 1.6223 E-06, 0.0/
C DATA REFT59/2.0855531E 07, GZ /9.80665/,
A AMZ /28.9644 /, RSTAR /8.31432/,
B FTTOKM/3.048E-04 /, S /110.4 /,
C AMUZ /1.2024E-05 /, CAZ /1116.45/,
D RHDZ /0.076474 /, GZENG /32.1741/
C CONVERT GEOMETRIC ALTITUDE TO GEOPOTENTIAL ALTITUDE
HFT = (REFT59/(REFT59+ZFT))*ZFT
C CONVERT HFT AND ZFT TO KILOMETERS
Z = FTTOKM*ZFT
H = FTTOKM*HFT
K = 1
TMZ = TMB(2)
IF (H.LT.-5.0.OR.Z.GT.90.0) GO TO 16
DO 10 M=1,10
IF (H-HB(M)) 11,12,10
10 CONTINUE
GO TO 16
11 M = M-1
12 DELH = H-HB(M)
IF (ALM(M).EQ.0.0) GO TO 13
TMK = TMB(M)-ALM(M)*DELH
C GRADIENT IS NON ZERO, PAGE 10, EQUATION I.2.10-(3)
DELTA = DELTAB(M)*((TMB(M)/TMK)**(GZ*AMZ/(RSTAR*ALM(M))))

```

```

      GO TO 14
13  TMK = TMB(M)
C  GRADIENT IS ZERO, PAGE 10, EQUATION I.2.10-(4)
      DELTA = DELTAB(M)*EXP(-GZ*AMZ*DELH/(RSTAR*TMB(M)))
14  THETA = TMK/TMZ
      SIGMA = DELTA/THETA
      ALPHA = SORT(THETA**3)*((TMZ+S)/(TMK+S))
C  CONVERSION TO ENGLISH UNITS
      TM = 1.8*TMK
      RHO = RHOZ*SIGMA/GZENG
      CA = CAZ*SORT(THETA)
      AMU = AMUZ*ALPHA/GZENG
      CALL OVERFL(J)
      GO TO (15,17), J
15  K = K+2
      GO TO 17
16  K = 2
17  RETURN
      END

```



```

$IBFTC PROCOM DECK
SUBROUTINE PROCOM(FARX,TEX,CSEX,AKEX,CPEX,REX,PHI,HEX)
IF (FARX.LE.0.067623) GO TO 1
FARX=0.067623
WRITE(6,101)
1 IF (TEX.GE.300.) GO TO 2
TEX=300.
WRITE(6,102)
2 IF (TEX.LE.4000.) GO TO 3
TEX=4000.
WRITE(6,103)
3 IF (FARX.GE.0.0) GO TO 4
FARX=0.0
WRITE(6,104)
C AIR PATH
4 CPA =(((((((1.0115540E-25*TEX-1.4526770E-21)*TEX
1 +7.6215767E-18)*TEX-1.5128259E-14)*TEX-6.7178376E-12)
2 *TEX+6.5519486E-08)*TEX-5.1536879E-05)*TEX+2.5020051E-01
HEA=(((((((1.2644425E-26*TEX-2.0752522E-22)*TEX
1 +1.2702630E-18)*TEX-3.0256518E-15)*TEX-1.6794594E-12)*TEX
2 +2.1839826E-08)*TEX-2.5768440E-05)*TEX+2.5020051E-01)*TEX
3 -1.7558886E+00
SEA=+2.5020051E-01*ALOG(TEX)+(((((((1.4450767E-26*TEX
1 -2.4211288E-22)*TEX+1.5243153E-18)*TEX-3.7820648E-15)*TEX
2 -2.2392790E-12)*TEX+3.2759743E-08)*TEX-5.1576879E-05)*TEX
3 +4.5432300E-02
IF (FARX.LE.0.0) GO TO 5
C FUEL/AIR PATH
CPF =(((((((7.2678710E-25*TEX-1.3335668E-20)*TEX
1 +1.0212913E-16)*TEX-4.2051104E-13)*TEX+9.9686793E-10)*TEX
2 -1.3771901E-06)*TEX+1.2258630E-03)*TEX+7.3816638E-02
HEF=(((((((9.0848388E-26*TEX-1.9050949E-21)*TEX
1 +1.7021525E-17)*TEX-8.4102208E-14)*TEX+2.4921698E-10)*TEX
2 -4.5906332E-07)*TEX+6.1293150E-04)*TEX+7.3816638E-02)
3 *TEX+3.0581530E+01
SEF=+7.3816638E-02*ALOG(TEX)+(((((((1.0382670E-25*TEX
1 -2.2226118E-21)*TEX+2.0425826E-17)*TEX-1.0512776E-13)*TEX
2 +3.3228928E-10)*TEX-6.8859505E-07)*TEX+1.2258630E-03)*TEX
3 +6.483398E-01
5 CPEX=(CPA+FARX*CPF)/(1.+FARX)
HEX=(HEA+FARX*HEF)/(1.+FARX)
PHI=(SEA+FARX*SEF)/(1.+FARX)
AMW=28.97-.946186*FARX
REX=1.986375/AMW
AKEX=CPEX/(CPEX-REX)
CSEX=SQRT(AKEX*REX*TEX*25031.37)
RETURN
101 FORMAT(1H0,64HINPUT FUEL-AIR RATIO ABOVE LIMITS, IT HAS BEEN RESET
2 TO 0.067623)
102 FORMAT(1H0,35HPROCOM INPUT TEMPERATURE BELOW 300.)
103 FORMAT(1H0,36HPROCOM INPUT TEMPERATURE ABOVE 4000.)
104 FORMAT(1H0,38HPROCOM INPUT FUEL-AIR RATIO BELOW ZERO)
END

```

```
SIBFTC THERMO DECK
SUBROUTINE THERMO(PX,HX,TX,SX,AMX,L,FAR,K)
FX=0.
IF(L.EQ.1) FX=FAR
IF(K.EQ.1) GO TO 1
CALL PROCOM(FX,TX,CS,AK,CP,R,PHI,HX)
GO TO 3
1 TX=4.*HX
DO 2 I=1,15
CALL PROCOM(FX,TX,CS,AK,CP,R,PHI,H)
DELH=HX-H
IF(ABS(DELH).LE.0.00001*HX) GO TO 3
2 TX=TX+4.*DELH
WRITE(6,100)
3 SX=PHI-R*ALOG(PX)
AMX=1.986375/R
RETURN
100 FORMAT(25HONO CONVERGENCE IN THERMO)
END
```

```

$IBFTC AFQUIR DECK
      SUBROUTINE AFQUIR(X,AIND,DEPEND,ANS,AJ,TOL,DIR,ANEW,ICON)
      DIMENSION X(9)
C X(1)=NAME OF ARRAY TO USE
C AIND=INDEPENDANT VARIABLE
C DEPEND= DEPENDANT VARIABLE
C ANS=ANSWER UPON WHICH TO CONVERGE
C AJ=MAX NUMBER OF TRYS
C TOL=PERCENT TOLERANCE FOR CONVERGENCE
C DIR=DIRECTION AND PERCENTAGE FOR FIKST GUESS
C ANEW=CALCULATED VALUE OF NEXT TRY AT INDEPENDANT VARIABLE
C ICON=CONTROL =1 GO THRU LOOP AGAIN
C           =2 YOU HAVE REACHED THE ANSWER
C           =3 COUNTER HAS HIT LIMITS
C X(2)=COUNTER STORAGE
C X(3)=CHOOSES METHOD OF CONVERGENCE
C X(4)=THIRD DEPEND VAR
C X(5)=THIRD IND VAR
C X(6)=SECOND DEPEND VAR
C X(7)=SECOND IND VAR
C X(8)=FIRST DEPEND VAR
C X(9)=FIRST IND VAR
C X(3) MUST BE ZERO UPON FIRST ENTRY TO ROUTINE

```

```

      Y=0.
      IF(ANS)1,2,1
1     DEP=DEPEND-ANS
      TOLANS=TOL*ANS
      GO TO 3
2     DEP=DEPEND
      TOLANS=TOL
3     IF(ABS(DEP)-TOLANS)5,5,4
4     IF(X(2)-AJ)8,8,7
5     ANEW=AIND
      X(2)=0.
      ICON=2
      RETURN
6     ANEW=Y
      X(2)=X(2)+1.
      ICON=1
      RETURN
7     ANEW=Y
      X(2)=0.
      ICON=3
      RETURN
8     IF(X(3))9,9,12
C *** FIRST GUESS USING DIR
9     X(3)=1.
      X(8)=DEP
      X(9)=AIND
      IF(AIND)10,11,10
10    Y=DIR*AIND
      GO TO 6
11    Y=DIR
      GO TO 6
12    IF(X(3)-1.)13,13,16
C *** LINEAR GUESS
13    X(3)=2.
      X(6)=DEP
      X(7)=AIND
      IF(X(8)-X(6))14,9,14

```

```

14 IF (X(9)-X(7))15,9,15
15 A=(X(9)-X(7))/(X(8)-X(6))
   Y=X(9)-A*X(8)
   IF (ABS(10.*X(9))-ABS(Y))9,9,6
-----
C *** QUADRATIC GUESS
16 X(4)=DEP
   X(5)=AIND
   IF (X(7)-X(5))18,17,18
17 IF (X(6)-X(4))13,9,13
18 IF (X(6)-X(4))19,13,19
-----
19 IF (X(9)-X(5))23,20,23
20 IF (X(8)-X(4))21,22,21
21 X(9)=X(7)
   X(8)=X(6)
   GO TO 13
-----
22 X(9)=X(7)
   X(8)=X(6)
   X(3)=1
   IF (X(9))10,11,10
23 IF (X(8)-X(4))24,21,24
24 F=(X(6)-X(4))/(X(7)-X(5))
   A=(X(8)-X(4)-F*(X(9)-X(5)))/((X(9)-X(7))*(X(9)-X(5)))
   C=F-A*(X(5)+X(7))
   G=X(4)+X(5)*(A*X(7)-F)
   IF (A)242,240,242
240 IF (B)241,7,241
241 Y=-C/B
   GO TO 37
-----
242 IF (B)247,243,247
243 IF (C)245,244,245
244 Y=0.
   GO TO 37
245 G=-C/A
   IF (G)7,7,246
-----
246 Y=SQRT(G)
   YY=-SQRT(G)
   GO TO 270
247 IF (C)249,248,249
248 Y=-B/A
   YY=0.
   GO TO 270
-----
249 D=4.*A*C/B**2
   IF (1.-D)13,25,26
25 Y=-B/(2.*A)
   GO TO 37
26 E=SQRT(1.-D)
27 Y=(-B/(2.*A))*(1.+E)
   YY=(-B/(2.*A))*(1.-E)
270 J=4
   DEPMIN=ABS(X(4))
   DO 29 I=6,8,2
   IF (DEPMIN-ABS(X(I)))29,29,28
-----
28 J=I
   DEPMIN=ABS(X(I))
29 CONTINUE
   K=J+1
   IF ((X(K)-Y)*(X(K)-YY))32,32,30
30 IF (ABS(X(K)-Y)-ABS(X(K)-YY))37,37,31
31 Y=YY
   GO TO 37
32 IF (J-6)33,34,34

```

```
33  JJ=J+2  
    KK=K+2  
    GO TO 35  
34  JJ=J-2  
    KK=K-2  
35  SLOPE=(X(KK)-X(K))/(X(JJ)-X(J))  
    IF(SLOPE*X(J)*(X(K)-Y))36,36,37  
36  Y=YY  
37  X(9)=X(7)  
    X(8)=X(6)  
    X(7)=X(5)  
    X(6)=X(4)  
    GO TO 6  
    END
```

EXAMPLE 1: SETUP OF CARPET DECK

```

$JOB          0,02,0900      68-XXX, NAME      SYMBOL
$IBJOB
$IBLDR CARPET

```

\$DKEND AFQUIR

\$DATA

```

$INPUT ALTP=0.0,AM=0.0,WAENG=115.,CV=0.985,PRC=12.5,ETAC=0.87,
ETATH=0.89,T4=2160.,DPE=0.01,ETAB=0.98,PCBLC=0.01,DPB=0.02,
PCBLT4=0.01,ITITLE=1$

```

TURBOJET - SINGLE-SPOOL (NO A/B)

\$INPUT T4=2200.\$

\$INPUT T4=2100.\$

\$EOF

\$DATA

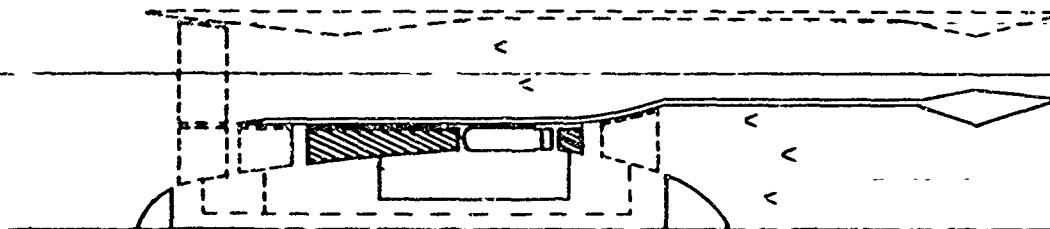
```

$INPUT ALTP=0.0,AM=0.0,WAENG=115.,CV=0.985,PRC=12.5,ETAC=0.87,
ETATH=0.89,T4=2160.,DPE=0.01,ETAB=0.98,PCBLC=0.01,DPB=0.02,
PCBLT4=0.01,ITITLE=1$

```

TURBOJET - SINGLE-SPOOL (NO A/B)

\$EOF



TURBOJET - SINGLE-SPOOL (NO A/B)

ALTP =	0.	AM =	0.	VA =	0.		
DELTO =	0.	ETAR =	1.00000	CS =	1116.45		
HPEXT =	0.	LCSL =	0.	HCSE =	0.		
PCBLOW =	0.	PCBLOB =	0.	PCBLNZ =	0.		
PCBLC =	0.01000	PCBLT4 =	0.01000	PCBLHP =	0.	PCBLLP =	0.
PROA =	12.500	BPR =	0.	WAENG =	115.00		
PRFT =	1.0000	ETAFT =	1.00000	WA24 =	0.	WA26 =	-0.
PRFH =	1.0000	ETAFH =	1.00000	WA21 =	115.000	BLLCSL =	0.
PRLP =	1.0000	ETALP =	1.00000	WA22 =	115.000	BLHCSL =	0.
PRC =	12.5000	ETAC =	0.87000	WA3 =	113.850		
DPD =	0.	DPFH =	0.	DPC =	0.		
PRESSURES IN ATMOSPHERES							
P1 =	1.000	T1 =	518.67	H1 =	123.92		
P2 =	1.000	T2 =	518.67	H2 =	123.92		
P21H =	1.000	T21 =	518.67	H21 =	123.92		
P21L =	1.000						
P22L =	1.000	T22 =	518.67	H22 =	123.92	BLOW =	0.
P22 =	1.000					BLOB =	0.
P3 =	12.500	T3 =	1135.75	H3 =	274.91	BLC =	1.150
P4 =	12.250	T4 =	2160.00	H4 =	560.29	WG4 =	115.686
DPB =	0.0200	ETAB =	0.98000	FAR4 =	0.01612	WF4 =	1.8355
P41 =	12.250	T41 =	2150.64	H41 =	557.48	BLT4 =	1.150
P5 =	3.264	T5 =	1623.58	H5 =	408.86	WG41 =	116.836
PRTH =	3.7526	ETATH =	0.89000	DPT =	0.		
P51 =	3.264	T51 =	1623.58	H51 =	408.86	BLHP =	0.
P55 =	3.265	T55 =	1623.58	H55 =	408.86	WG51 =	116.836
PRTL =	0.9998	ETATL =	1.00000	DPE =	0.01000		
P56 =	3.265	T56 =	1623.58	H56 =	408.86	BLLP =	0.
P6 =	3.232	T6 =	1623.58	H6 =	408.86	WG56 =	116.836
P7 =	3.232	T7 =	1623.58	H7 =	408.86	WG7 =	116.836
P8 =	3.232	T8 =	1623.58	H8 =	408.86	BLMOZ =	0.
V9 =	2342.97	TS9 =	1201.48	HS9 =	295.82	WG8 =	116.836
P24 =	0.	T24 =	0.	H24 =	0.		
P26 =	0.	T26 =	0.	H26 =	0.		
P27 =	0.	T27 =	0.	H27 =	0.	WG27 =	-0.
P28 =	0.	T28 =	0.	H28 =	0.	WG28 =	-0.
V29 =	0.	TS29 =	0.	HS29 =	0.		
FAR41 =	0.01596	FAR51 =	0.01596	FAR56 =	0.01596		
FAR7 =	0.01596	FAR8 =	0.01596	FAR27 =	-0.00000		
HV =	17360.2	HV7 =	-0.0	HV27 =	-0.0		
CV =	0.98500	V9 =	2342.97	V29 =	0.		
FN/WA =	73.984	THG9 =	73.984	THG29 =	-0.		
ETAP =	0.	ETATHM =	0.	ETAD =	0.		
SFCU =	0.77666	FG =	8508.2	FN =	8508.2		

THIS PROGRAM WAS DEVELOPED BY FUTILITY AIRCRAFT, UNINC.
COMPONENTS BRANCH TURBINE ENGINE DIVISION
U.S. AIR FORCE AERO PROPULSION LABORATORY

AFAPL-TR-68-88

```
$DATA
$INPUT ALTP=0.0,AM=0.0,WAENG=115.,CV=0.985,PRC=12.5,ETAC=0.87,
ETATH=0.89,T4=2160.,DPE=0.01,ETAB=0.98,PCBLC=0.01,DPB=0.02,
IDEL=1,
PCBLT4=0.01,ITITLE=1$
  DESIGN DERIVATIVE - TURBOJET - SINGLE-SPOOL (NO A/B)
ETAC      DELTA      0.01
PRC       PERCNT     0.02
CV        DELTA      0.015   PLUS
T4        DELTA      100.
GOON
$EOF
```


DESIGN DERIVATIVE - TURBOJET - SINGLE-SPOOL (NO A/B)
 BASE POINT

ALTP = 0.	Am = 0.	VA = 0.		
DELTO = 0.	ETAR = 1.00000	CS = 1116.45		
HPEXT = 0.	LCSL = 0.	HCSL = 0.		
PCBLOW = 0.	PCBLOB = 0.	PCBLNZ = 0.		
PCBLC = 0.01000	PCBLT4 = 0.01000	PCBLHP = 0.	PCBLLP = 0.	
PROA = 12.500	BPR = 0.	WAENG = 115.00		
PRFT = 1.0000	ETAFT = 1.00000	WA24 = 0.	WA26 = -0.	
PRFH = 1.0000	ETAFH = 1.00000	WA21 = 115.000	BLCSL = 0.	
PRLP = 1.0000	ETALP = 1.00000	WA22 = 115.000	BLHCSL = 0.	
PRC = 12.5000	ETAC = 0.87000	WA3 = 113.850		
DPD = 0.	DPFH = 0.	OPC = 0.		

PRESSURES IN ATMOSPHERES

P1 = 1.000	T1 = 518.67	H1 = 123.92		
P2 = 1.000	T2 = 518.67	H2 = 123.92		
P21H = 1.000	T21 = 518.67	H21 = 123.92		
P21L = 1.000				
P22L = 1.000	T22 = 518.67	H22 = 123.92	BLOW = 0.	
P22 = 1.000			BL08 = 0.	
P3 = 12.500	T3 = 1135.75	H3 = 274.91	BLC = 1.150	
P4 = 12.250	T4 = 2160.00	H4 = 560.29	WG4 = 115.686	
DPB = 0.0200	ETAB = 0.98000	FAR4 = 0.01612	WF4 = 1.8355	
P41 = 12.250	T41 = 2150.64	H41 = 557.48	BLT4 = 1.150	
P5 = 3.264	T5 = 1623.58	H5 = 408.86	WG41 = 116.836	
PRTH = 3.7526	ETATH = 0.89000	DPT = 0.		
P51 = 3.264	T51 = 1623.58	H51 = 408.86	BLHP = 0.	
P55 = 3.265	T55 = 1623.58	H55 = 408.86	WG51 = 116.836	
PRTL = 0.9998	ETATL = 1.00000	DPE = 0.01000		
P56 = 3.265	T56 = 1623.58	H56 = 408.86	BLLP = 0.	
P6 = 3.232	T6 = 1623.58	H6 = 408.86	WG56 = 116.836	
P7 = 3.232	T7 = 1623.58	H7 = 408.86	WG7 = 116.836	
P8 = 3.232	T8 = 1623.58	H8 = 408.86	BLMUZ = 0.	
V9 = 2342.97	TS9 = 1201.48	HS9 = 295.82	WG8 = 116.836	
P24 = 0.	T24 = 0.	H24 = 0.		
P26 = 0.	T26 = 0.	H26 = 0.		
P27 = 0.	T27 = 0.	H27 = 0.	WG27 = -0.	
P28 = 0.	T28 = 0.	H28 = 0.	WG28 = -0.	
V29 = 0.	TS29 = 0.	HS29 = 0.		
FAR41 = 0.01596	FAR51 = 0.01596	FAR56 = 0.01596		
FAR7 = 0.01596	FAR8 = 0.01596	FAR27 = -0.00000		
HV = 17360.2	HV7 = -0.0	HV27 = -0.0		
CV = 0.98500	V9 = 2342.97	V29 = 0.		
FM/VA = 73.984	THG9 = 73.984	THG29 = -0.		
ETAP = 0.	ETATH = 0.	ETA0 = 0.		
SFCU = 0.77666	FG = 8508.2	FM = 8508.2		
SFC/SFCB = 1.00000	FM/FMB = 1.00000			

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DESIGN DERIVATIVE - TURBOJET - SINGLE-SPOOL (NO A/B)
 BASE POINT - VARYING ETAC BY + 1.1 PERCENT (DELTA = 0.010)

ALTP = 0. AM = 0. VA = 0.
 DELTO = 0. ETAR = 1.00000 CS = 1116.45

HPEXT = 0. LCSL = 0. HCSL = 0.
 PCBLOW = 0. PCBLOB = 0. PCBLN2 = 0.
 PCBLC = 0.01000 PCBLT4 = 0.01000 PCBLHP = 0. PCBLLP = 0.
 PROA = 12.500 BPR = 0. WAENG = 115.00

PRFT = 1.0000 ETAFT = 1.00000 WA24 = 0. WA26 = -0.
 PRFH = 1.0000 ETAFH = 1.00000 WA21 = 115.000 BLLCSL = 0.
 PRLP = 1.0000 ETALP = 1.00000 WA22 = 115.000 BLHCSL = 0.
 PRC = 12.5000 ETAC = 0.88000 WA3 = 113.850
 DPD = 0. DPFH = 0. DPC = 0.

PRESSURES IN ATMOSPHERES

P1 = 1.000 T1 = 518.67 H1 = 123.92
 P2 = 1.000 T2 = 518.67 H2 = 123.92
 P21H = 1.000 T21 = 518.67 H21 = 123.92
 P21L = 1.000
 P22L = 1.000 T22 = 518.67 H22 = 123.92 BLOW = 0.
 P22 = 1.000 BLOB = 0.
 P3 = 12.500 T3 = 1128.96 H3 = 273.19 BLC = 1.150
 P4 = 12.250 T4 = 2160.00 H4 = 560.35 WG4 = 115.697
 DPB = 0.0200 ETAB = 0.98000 FAR4 = 0.01622 WF4 = 1.8470
 P41 = 12.250 T41 = 2150.58 H41 = 557.53 BLT4 = 1.150
 P5 = 3.323 T5 = 1629.81 H5 = 410.61 WG41 = 116.847
 PRTH = 3.6861 ETATH = 0.89000 DPT = 0.
 P51 = 3.323 T51 = 1629.81 H51 = 410.61 BLHP = 0.
 P55 = 3.324 T55 = 1629.81 H55 = 410.61 WG51 = 116.847
 PRTL = 0.9998 ETATL = 1.00000 DPE = 0.01000
 P56 = 3.324 T56 = 1629.81 H56 = 410.61 BLLP = 0.
 P6 = 3.291 T6 = 1629.81 H6 = 410.61 WG56 = 116.847
 P7 = 3.291 T7 = 1629.81 H7 = 410.61 WG7 = 116.847
 P8 = 3.291 T8 = 1629.81 H8 = 410.61 BLMOZ = 0.
 V9 = 2362.84 TS9 = 1200.73 HS9 = 295.65 WG8 = 116.847

P24 = 0. T24 = 0. H24 = 0.
 P26 = 0. T26 = 0. H26 = 0.
 P27 = 0. T27 = 0. H27 = 0. WG27 = -0.
 P28 = 0. T28 = 0. H28 = 0. WG28 = -0.
 V29 = 0. TS29 = 0. HS29 = 0.

FAR41 = 0.01606 FAR51 = 0.01606 FAR56 = 0.01606
 FAR7 = 0.01606 FAR8 = 0.01606 FAR27 = -0.00000
 HV = 17360.2 HV7 = -0.0 HV27 = -0.0
 CV = 0.98500 V9 = 2362.84 V29 = 0.

FM/MA = 74.619 THG9 = 74.619 THG29 = -0.
 ETAP = 0. ETATH = 0. ETAU = 0.
 SFCU = 0.77487 FG = 8581.2 FN = 8581.2
 SFC/SFCR = 0.99770 FM/FMB = 1.00858

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DESIGN DERIVATIVE - TURBOJET - SINGLE-SPOOL (NO A/B)
 BASE POINT - VARYING ETAC BY - 1.1 PERCENT (DELTA = 0.010)

ALTP = 0. A_P = 0. VA = 0.
 DELTO = 0. ETAR = 1.00000 CS = 1116.45

HPEXT = 0. LC SL = 0. HC SL = 0.
 PCBLOW = 0. PCBLOS = 0. PCB LNZ = 0.
 PCBLC = 0.01000 PCB LT4 = 0.01000 PCB LHP = 0. PCB LLP = 0.
 PROA = 12.500 BPR = 0. HAENG = 115.00
 PRFT = 1.0000 ETA FT = 1.00000 WA24 = 0. WA26 = -0.
 PRFH = 1.0000 ETA FH = 1.00000 WA21 = 115.000 BLICSL = 0.
 PRLP = 1.0000 ETALP = 1.00000 WA22 = 115.000 BLHC SL = 0.
 PRC = 12.50000 ETAC = 0.86000 WA3 = 113.850
 DPD = 0. DPFH = 0. DPC = 0.

PRESSURES IN ATMOSPHERES

P1 = 1.000	T1 = 518.67	H1 = 123.92	
P2 = 1.000	T2 = 518.67	H2 = 123.92	
P21H = 1.000	T21 = 518.67	H21 = 123.92	
P21L = 1.000			
P22L = 1.000	T22 = 518.67	H22 = 123.92	BLOW = 0.
P22 = 1.000			BLOS = 0.
P3 = 12.500	T3 = 1142.70	H3 = 276.67	BLC = 1.150
P4 = 12.250	T4 = 2160.00	H4 = 560.22	EG4 = 115.674
DPB = 0.0200	ETAB = 0.98000	FAR4 = 0.01602	WF4 = 1.8238
P41 = 12.250	T41 = 2150.69	H41 = 557.43	SLT4 = 1.150
P5 = 3.205	T5 = 1617.20	H5 = 407.06	GG41 = 116.824
PRTH = 3.8222	ETATH = 0.89000	DPT = 0.	
P51 = 3.205	T51 = 1617.20	H51 = 407.06	BLEP = 0.
P55 = 3.205	T55 = 1617.20	H55 = 407.06	GG51 = 116.824
PRTL = 0.9998	ETATL = 1.00000	DPE = 0.01000	
P56 = 3.205	T56 = 1617.20	H56 = 407.06	BLLP = 0.
P6 = 3.173	T6 = 1617.20	H6 = 407.06	GG56 = 116.824
P7 = 3.173	T7 = 1617.20	H7 = 407.06	GG7 = 116.824
P8 = 3.173	T8 = 1617.20	H8 = 407.06	BL90Z = 0.
V9 = 2322.44	TS9 = 1202.26	HS9 = 296.00	GG8 = 116.824
P24 = 0.	T24 = 0.	H24 = 0.	
P26 = 0.	T26 = 0.	H26 = 0.	
P27 = 0.	T27 = 0.	H27 = 0.	GG27 = -0.
P28 = 0.	T28 = 0.	H28 = 0.	GG28 = -0.
V29 = 0.	TS29 = 0.	HS29 = 0.	
FAR41 = 0.01586	FAR51 = 0.01586	FAR56 = 0.01586	
FAR7 = 0.01586	FAR8 = 0.01586	FAR27 = 0.00000	
HV = 17360.2	HV7 = -0.0	HV27 = -0.0	
CV = 0.98500	V9 = 2322.44	V29 = 0.	

FM/VA = 73.328 THG9 = 73.328 THG29 = -0.
 ETAP = 0. ETATH = 0. ETATL = 0.
 SFCU = 0.77859 FG = 8432.5 FM = 8432.5
 SFC/SFCB = 1.00245 FM/FMB = 0.99114

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DESIGN DERIVATIVE - TURBOJET - SINGLE-SPOOL (61 A/S)
 BASE POINT - VARYING PRC BY + 2.0 PERCENT (DELTA = 0.250)

ALTP = 0. AM = 0. VA = 0.
 DELTO = 0. ETAR = 1.00000 CS = 1116.45

HPEXT = 0. LCSL = 0. HCSL = 0.
 PCBLDH = 0. PCBLDB = 0. PCBLAZ = 0.
 PCBLC = 0.01000 PCBLT4 = 0.01000 PCBLHP = 0. PCBLLP = 0.
 PROA = 12.750 SPR = 0. WAEMG = 115.00

PRFT = 1.0000 ETAFH = 1.00000 WA24 = 0. WA26 = -0.
 PRFH = 1.0000 ETAFH = 1.00000 WA21 = 115.000 WLLCSL = 0.
 PRLP = 1.0000 ETALP = 1.00000 WA22 = 115.000 WLLHCSL = 0.
 PRC = 12.7500 ETAC = 0.87000 WA3 = 113.950
 DPD = 0. DPFH = 0. DPC = 0.

PRESSURES IN ATMOSPHERES

P1 = 1.000	T1 = 518.67	H1 = 123.92	
P2 = 1.000	T2 = 518.67	H2 = 123.92	
P21H = 1.000	T21 = 518.67	H21 = 123.92	
P21L = 1.000			
P22L = 1.000	T22 = 518.67	H22 = 123.92	BLDB = 0.
P22 = 1.000			BLDB = 0.
P3 = 12.750	T3 = 1142.29	H3 = 276.56	BLC = 1.150
P4 = 12.495	T4 = 2160.00	H4 = 560.22	SG4 = 115.674
DPB = 0.0200	ETAB = 0.98000	FAR4 = 0.01603	PF4 = 1.6245
P41 = 12.495	T41 = 2150.69	H41 = 557.45	BLT4 = 1.150
P5 = 3.273	T5 = 1617.57	H5 = 407.17	SG41 = 116.824
PRTH = 3.8181	ETATH = 0.89000	DPT = 0.	
P51 = 3.273	T51 = 1617.57	H51 = 407.17	SLHP = 0.
P55 = 3.273	T55 = 1617.58	H55 = 407.17	SG51 = 116.824
PRTL = 0.9998	ETATL = 1.00000	DPE = 0.01000	
P56 = 3.273	T56 = 1617.58	H56 = 407.17	SLLP = 0.
P6 = 3.240	T6 = 1617.58	H6 = 407.17	SG56 = 116.824
P7 = 3.240	T7 = 1617.58	H7 = 407.17	SG7 = 116.824
P8 = 3.240	T8 = 1617.58	H8 = 407.17	BLAZ = 0.
V9 = 2340.60	TS9 = 1195.96	HS9 = 294.36	SG8 = 116.824

P24 = 0.	T24 = 0.	H24 = 0.	
P26 = 0.	T26 = 0.	H26 = 0.	
P27 = 0.	T27 = 0.	H27 = 0.	SG27 = -0.
P28 = 0.	T28 = 0.	H28 = 0.	SG28 = -0.
V29 = 0.	TS29 = 0.	HS29 = 0.	

FAR41 = 0.01587	FAR51 = 0.01587	FAR56 = 0.01587
FAR7 = 0.01587	FAR8 = 0.01587	FAR27 = -0.00000
HV = 17360.2	HV7 = -0.0	HV27 = -0.0
CV = 0.96500	V9 = 2340.60	V29 = 0.

FN/VA = 73.902	THG9 = 73.902	THG29 = -0.
ETAP = 0.	ETATH = 0.	ETAU = 0.
SFCU = 0.77283	FG = 8498.8	Fm = 8498.8
SFC/SFCB = 0.99507		Fo/FoL = 0.99389

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DESIGN DERIVATIVE - TURBOJET - SINGLE-SPOOL (NO A/B)
 BASE POINT - VARYING PRC BY - 2.0 PERCENT (DELTA = 0.250)

ALTP = 0. AM = 0. VA = 0.
 DELTO = 0. ETAR = 1.00000 CS = 1116.45

HPEXT = 0. LCSL = 0. HCSL = 0.
 PCBL0W = 0. PCBL0B = 0. PCBLNZ = 0.
 PC6LC = 0.01000 PCBLT4 = 0.01000 PCBLHP = 0. PCBLLP = 0.
 PROA = 12.250 BPR = 0. WAENG = 115.00

PRFT = 1.0000 ETAFT = 1.00000 WA24 = 0. WA26 = -0.
 PRFH = 1.0000 ETAFH = 1.00000 WA21 = 115.000 BLLCSL = 0.
 PRLP = 1.0000 ETALP = 1.00000 WA22 = 115.000 BLHC SL = 0.
 PRC = 12.2500 ETAC = 0.87000 WA3 = 113.850
 DPD = 0. DPFH = 0. DPC = 0.

PRESSURES IN ATMOSPHERES

P1 = 1.000	T1 = 518.67	H1 = 123.92	
P2 = 1.000	T2 = 518.67	H2 = 123.92	
P21H = 1.000	T21 = 518.67	H21 = 123.92	
P21L = 1.000			
P22L = 1.000	T22 = 518.67	H22 = 123.92	BLOW = 0.
P22 = 1.000			SLUB = 0.
P3 = 12.250	T3 = 1129.11	H3 = 273.23	BLC = 1.150
P4 = 12.005	T4 = 2160.00	H4 = 560.35	WG4 = 115.697
DPB = 0.0200	ETAB = 0.98000	FAR4 = 0.01622	WF4 = 1.8468
P41 = 12.005	T41 = 2150.58	H41 = 557.53	BLT4 = 1.150
P5 = 3.256	T5 = 1629.67	H5 = 410.57	WG41 = 116.847
PRTH = 3.6875	ETATH = 0.89000	DPT = 0.	
P51 = 3.256	T51 = 1629.67	H51 = 410.57	BLHP = 0.
P55 = 3.256	T55 = 1629.67	H55 = 410.57	WG51 = 116.847
PRTL = 0.9998	ETATL = 1.00000	DPE = 0.01000	
P56 = 3.256	T56 = 1629.67	H56 = 410.57	BLLP = 0.
P6 = 3.224	T6 = 1629.67	H6 = 410.57	WG56 = 116.847
P7 = 3.224	T7 = 1629.67	H7 = 410.57	WG7 = 116.847
P8 = 3.224	T8 = 1629.67	H8 = 410.57	BLMOZ = 0.
V9 = 2345.19	TS9 = 1207.14	HS9 = 297.33	WG8 = 116.847

P24 = 0.	T24 = 0.	H24 = 0.	
P26 = 0.	T26 = 0.	H26 = 0.	
P27 = 0.	T27 = 0.	H27 = 0.	WG27 = -0.
P28 = 0.	T28 = 0.	H28 = 0.	WG28 = -0.
V29 = 0.	TS29 = 0.	HS29 = 0.	

FAR41 = 0.01606	FAR51 = 0.01606	FAR56 = 0.01606
FAR7 = 0.01606	FAR8 = 0.01606	FAR27 = -0.00000
HV = 17360.2	HV7 = -0.0	HV27 = -0.0
CV = 0.98500	V9 = 2345.19	V29 = 0.

FN/WA = 74.061	THG9 = 74.061	THG29 = -0.
ETAP = 0.	ETATH = 0.	ETAO = 0.
SFCU = 0.78060	FG = 8517.0	FN = 8517.0
SFC/SFCB = 1.00507		FN/FNB = 1.00104

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DESIGN DERIVATIVE - TURBOJET - SINGLE-SPOOL (NO A/B)
 BASE POINT - VARYING CV BY + 1.5 PERCENT (DELTA = 0.015)

ALTP = 0. Am = 0. VA = 0.
 DELTO = 0. ETAR = 1.00000 CS = 1116.45

HPEXT = 0. LCSL = 0. HCSE = 0.
 PCBLOW = 0. PCBLOB = 0. PCBLENZ = 0.
 PCBLC = 0.01000 PCSLT4 = 0.01000 PCBHP = 0. PCBLLP = 0.
 PROA = 12.500 BPR = 0. WAENG = 115.00
 PRFT = 1.0000 ETAFT = 1.00000 WA24 = 0. WA26 = -0.
 PRFH = 1.0000 ETAFH = 1.00000 WA21 = 115.000 BLLCSL = 0.
 PRLP = 1.0000 ETALP = 1.00000 WA22 = 115.000 BLHCSL = 0.
 PRC = 12.5000 ETAC = 0.87000 WA3 = 113.850
 DPD = 0. DPFH = 0. DPC = 0.

PRESSURES IN ATMOSPHERES

P1 = 1.000	T1 = 518.67	H1 = 123.92	
P2 = 1.000	T2 = 518.67	H2 = 123.92	
P21H = 1.000	T21 = 518.67	H21 = 123.92	
P21L = 1.000			
P22L = 1.000	T22 = 518.67	H22 = 123.92	BLOW = 0.
P22 = 1.000			BLUB = 0.
P3 = 12.500	T3 = 1135.75	H3 = 274.91	BLC = 1.150
P4 = 12.250	T4 = 2160.00	H4 = 560.29	WG4 = 115.686
DP8 = 0.0200	ETAB = 0.98000	FAR4 = 0.01612	WF4 = 1.8355
P41 = 12.250	T41 = 2150.64	H41 = 557.48	BLT4 = 1.150
P5 = 3.264	T5 = 1623.58	H5 = 408.86	WG41 = 116.836
PRTH = 3.7526	ETATH = 0.89000	DPT = 0.	
P51 = 3.264	T51 = 1623.58	H51 = 408.86	BLHP = 0.
P55 = 3.265	T55 = 1623.58	H55 = 408.86	WG51 = 116.836
PRTL = 0.9998	ETATL = 1.00000	DPE = 0.01000	
P56 = 3.265	T56 = 1623.58	H56 = 408.86	BLLP = 0.
P6 = 3.232	T6 = 1623.58	H6 = 408.86	WG56 = 116.836
P7 = 3.232	T7 = 1623.58	H7 = 408.86	WG7 = 116.836
P8 = 3.232	T8 = 1623.58	H8 = 408.86	BLMOZ = 0.
V9 = 2378.65	TS9 = 1201.48	HS9 = 295.82	WG8 = 116.836
P24 = 0.	T24 = 0.	H24 = 0.	
P26 = 0.	T26 = 0.	H26 = 0.	
P27 = 0.	T27 = 0.	H27 = 0.	WG27 = -0.
P28 = 0.	T28 = 0.	H28 = 0.	WG28 = -0.
V29 = 0.	TS29 = 0.	HS29 = 0.	

FAR41 = 0.01596 FAR51 = 0.01596 FAR56 = 0.01596
 FAR7 = 0.01596 FAR8 = 0.01596 FAR27 = -0.00000
 HV = 17360.2 HV7 = -0.0 HV27 = -0.0
 CV = 1.00000 V9 = 2378.65 V29 = 0.

FN/WA = 75.111 THG9 = 75.111 THG29 = -0.
 ETAP = 0. ETATH = 0. ETAD = 0.
 SFCU = 0.76501 FG = 8637.7 FN = 8637.7
 SFC/SFCB = 0.98500 FN/FNR = 1.01523

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DESIGN DERIVATIVE - TURBOJET - SINGLE-SPOOL (NO A/B)
 BASE POINT - VARYING T4 BY + 4.6 PERCENT (DELTA = 100.000)

ALTP = 0. Aft = 0. VA = 0.
 DELTO = 0. ETAR = 1.00000 CS = 1116.45

HPEXT = 0. LCSL = 0. HCSSL = 0.
 PCBLOH = 0. PCBLOB = 0. PCBLOZ = 0.
 PCBLC = 0.01000 PCBLT4 = 0.01000 PCBLHP = 0. PCBLLP = 0.
 PROA = 12.500 BPR = 0. WAENG = 115.00
 PRFT = 1.0000 ETAFH = 1.00000 WA24 = 0. WA26 = -0.
 PRFH = 1.0000 ETAFH = 1.00000 WA21 = 115.000 BLLECSL = 0.
 PRLP = 1.0000 ETALP = 1.00000 WA22 = 115.000 BLHCSSL = 0.
 PRC = 12.5000 ETAC = 0.87000 WA3 = 113.850
 DPD = 0. DPFH = 0. DPC = 0.

PRESSURES IN ATMOSPHERES

P1 = 1.000 T1 = 518.67 H1 = 123.92
 P2 = 1.000 T2 = 518.67 H2 = 123.92
 P21H = 1.000 T21 = 518.67 H21 = 123.92
 P21L = 1.000
 P22L = 1.000 T22 = 518.67 H22 = 123.92 BLOW = 0.
 P22 = 1.000 ELUB = 0.
 P3 = 12.500 T3 = 1135.75 H3 = 274.91 FLC = 1.150
 P4 = 12.250 T4 = 2260.00 H4 = 590.53 WG4 = 115.883
 DP8 = 0.0200 ETAS = 0.98000 FAR4 = 0.01786 WF4 = 2.0333
 P41 = 12.250 T41 = 2249.79 H41 = 587.42 BLT4 = 1.150
 P5 = 3.512 T5 = 1729.95 H5 = 439.05 WG41 = 117.033
 BRTH = 3.4878 ETATH = 0.89000 DPT = 0.
 P51 = 3.512 T51 = 1729.95 H51 = 439.05 BLHP = 0.
 P55 = 3.513 T55 = 1729.96 H55 = 439.05 WG51 = 117.033
 PRTL = 0.9998 ETATL = 1.00000 DPE = 0.01000
 P56 = 3.513 T56 = 1729.96 H56 = 439.05 BLLEP = 0.
 P6 = 3.478 T6 = 1729.96 H6 = 439.05 WG56 = 117.033
 P7 = 3.478 T7 = 1729.96 H7 = 439.05 WG7 = 117.033
 P8 = 3.478 T8 = 1729.96 H8 = 439.05 BLMOZ = 0.
 V9 = 2484.42 TS9 = 1261.29 HS9 = 311.96 WG2 = 117.033
 P24 = 0. T24 = 0. H24 = 0.
 P26 = 0. T26 = 0. H26 = 0.
 P27 = 0. T27 = 0. H27 = 0. WG27 = -0.
 P28 = 0. T28 = 0. H28 = 0. WG28 = -0.
 V29 = 0. TS29 = 0. HS29 = 0.
 FAR41 = 0.01768 FAR51 = 0.01768 FAR56 = 0.01768
 FAR7 = 0.01768 FAR8 = 0.01768 FAR27 = -0.00000
 HV = 17280.5 HV7 = -0.0 HV27 = -0.0
 CV = 0.98500 V9 = 2484.42 V29 = 0.

FH/FA = 78.583 THG9 = 78.583 THG29 = -0.
 ETAP = 0. ETATH = 0. ETAU = 0.
 SFCU = 0.80996 FE = 9037.1 FE = 9037.1
 SFC/SFCB = 1.04288 FE/FEB = 1.06217

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 U.S. AIR FORCE AERO PROPULSION LABORATORY

DESIGN DERIVATIVE - TURBOJET - SINGLE-SPOOL (NO A/B)
 BASE POINT - VARYING T4 BY - 4.6 PERCENT (DELTA = 100.000)

ALTP = 0. AH = 0. VA = 0.
 DELTO = 0. ETAR = 1.00000 CS = 1116.45

HPEXT = 0. LCSL = 0. HCSL = 0.
 PCBL0W = 0. PCBL0B = 0. PCBLWZ = 0.
 PCBLC = 0.01000 PCBLT4 = 0.01000 PCBLHP = 0. PCBLLP = 0.
 PRUA = 12.500 BPR = 0. WAENG = 115.00
 PRFT = 1.0000 ETAFT = 1.00000 WA24 = 0. WA26 = -0.
 PRFH = 1.0000 ETAFH = 1.00000 WA21 = 115.000 BLCSL = 0.
 PRLP = 1.0000 ETALP = 1.00000 WA22 = 115.000 BLHCSL = 0.
 PRC = 12.5000 ETAC = 0.87000 WA3 = 113.850
 DPD = 0. DPFH = 0. DPC = 0.

PRESSURES IN ATMOSPHERES

P1 = 1.000 T1 = 518.67 H1 = 123.92
 P2 = 1.000 T2 = 518.67 H2 = 123.92
 P21H = 1.000 T21 = 518.67 H21 = 123.92
 P21L = 1.000
 P22L = 1.000 T22 = 518.67 H22 = 123.92 BLOW = 0.
 P22 = 1.000 BLOB = 0.
 P3 = 12.500 T3 = 1135.75 H3 = 274.91 BLC = 1.150
 P4 = 12.250 T4 = 2060.00 H4 = 530.45 HG4 = 115.491
 DPB = 0.0200 ETAB = 0.98000 FAR4 = 0.01441 HF4 = 1.6411
 P41 = 12.250 T41 = 2051.49 H41 = 527.93 BLT4 = 1.150
 P5 = 3.007 T5 = 1516.82 H5 = 379.06 HG41 = 116.641
 PRTH = 4.0741 ETATH = 0.89000 DPT = 0.
 P51 = 3.007 T51 = 1516.82 H51 = 379.06 BLHP = 0.
 P55 = 3.007 T55 = 1516.82 H55 = 379.06 HG51 = 116.641
 PRTL = 0.9998 ETATL = 1.00000 DPE = 0.01000
 P56 = 3.007 T56 = 1516.82 H56 = 379.06 BLUP = 0.
 P6 = 2.977 T6 = 1516.82 H6 = 379.06 HG56 = 116.641
 P7 = 2.977 T7 = 1516.82 H7 = 379.06 HG7 = 116.641
 P8 = 2.977 T8 = 1516.82 H8 = 379.06 BLNOZ = 0.
 V9 = 2192.59 TS9 = 1142.38 HS9 = 280.07 H9 = 116.641
 P24 = 0. T24 = 0. H24 = 0.
 P26 = 0. T26 = 0. H26 = 0.
 P27 = 0. T27 = 0. H27 = 0. HG27 = -0.
 P28 = 0. T28 = 0. H28 = 0. HG28 = -0.
 V29 = 0. TS29 = 0. HS29 = 0.

FAR41 = 0.01427 FAR51 = 0.01427 FAR56 = 0.01427
 FAR7 = 0.01427 FAR8 = 0.01427 FAR27 = -0.00000
 HV = 17438.4 HV7 = -0.0 HV27 = -0.0
 CV = 0.98500 V9 = 2192.59 V29 = 0.

FN/WA = 69.120 THG9 = 69.120 THG29 = -0.
 ETAP = 0. ETATH = 0. ETAP = 0.
 SFCU = 0.74323 FG = 7948.8 FN = 7948.8
 SFC/SFCB = 0.95695 FM/FMB = 0.93426

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AFAPL-TR-68-88

SDATA

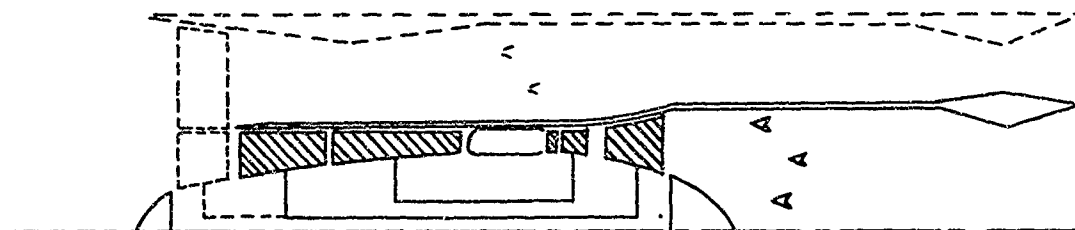
\$INPUT ALTP=0.0,AM=0.0,PRES=14.696,WAENG=120.,CV=0.985,
PRLP=3.0,PRC=4.0,ETALP=0.83,ETAC=0.81,ETATH=0.88,ETATL=0.89,
T4=2000.,DPE=0.02,ETAB=0.97,PCBLOW=0.01,PCBLC=0.0075,
DPB=0.04,PCBLT4=0.0075,ITITLE=1\$

TURBOJET - TWO-SPOOL

\$INPUT T4=2050.,T7=3250.,ETABAB=0.87,DPBAB=0.095,IAFTBN=1,ITITLE=1\$

TURBOJET - TWO-SPOOL (WITH A/B)

SEOF



TURBOJET - TWO-SPOOL

ALTP = 0.	AM = 0.	VA = 0.	
DELTO = 0.	ETAR = 1.00000	CS = 1116.45	
HPEXT = 0.	LCSL = 0.	HCSL = 0.	
PCBLOW = 0.01000	PCBLOB = 0.	PCBLNZ = 0.	
PCBLC = 0.00750	PCBLT4 = 0.00750	PCBLHP = 0.	PCBLLP = 0.
PROA = 12.000	6PR = 0.	WAENG = 120.00	
PRFT = 1.0000	ETAFT = 1.00000	WA24 = 0.	WA26 = -0.
PRFH = 1.0000	ETAFTH = 1.00000	WA21 = 120.000	BLCSL = 0.
PRLP = 3.0000	ETALP = 0.83000	WA22 = 118.800	BLHCSL = 0.
PRC = 4.0000	ETAC = 0.81000	WA3 = 117.909	
DPD = 0.	DPFH = 0.	DPC = 0.	

PRESSURES IN LBS/SQ INCH

P1 = 14.696	T1 = 518.67	H1 = 123.92	
P2 = 14.696	T2 = 518.67	H2 = 123.92	
P21H = 14.696	T21 = 518.67	H21 = 123.92	
P21L = 14.696			
P22L = 44.088	T22 = 748.82	H22 = 179.28	BLOW = 1.200
P22 = 44.088			BLOB = 0.
P3 = 176.352	T3 = 1182.02	H3 = 286.64	BLC = 0.891
P4 = 169.298	T4 = 2000.00	H4 = 512.41	WG4 = 119.424
DP6 = 0.0400	ETAB = 0.97000	FAR4 = 0.01285	WF4 = 1.5151
P41 = 169.298	T41 = 1994.32	H41 = 510.73	BLT4 = 0.891
P5 = 62.783	T5 = 1613.52	H5 = 404.73	WG41 = 120.315
PRTH = 2.6965	ETATH = 0.88000	DPT = 0.	
P51 = 62.783	T51 = 1613.52	H51 = 404.73	BLHP = 0.
P55 = 34.304	T55 = 1408.84	H55 = 349.51	WG51 = 120.315
PRTL = 1.8302	ETATL = 0.89000	DPE = 0.02000	
P56 = 34.304	T56 = 1408.84	H56 = 349.51	BLLP = 0.
P6 = 33.618	T6 = 1408.84	H6 = 349.51	WG56 = 120.315
P7 = 33.618	T7 = 1408.84	H7 = 349.51	WG7 = 120.315
P8 = 33.618	T8 = 1408.84	H8 = 349.51	BLNOZ = 0.
V9 = 1867.23	TS9 = 1154.67	HS9 = 277.72	WG8 = 120.315
P24 = 0.	T24 = 0.	H24 = 0.	
P26 = 0.	T26 = 0.	H26 = 0.	
P27 = 0.	T27 = 0.	H27 = 0.	WG27 = -0.
P28 = 0.	T28 = 0.	H28 = 0.	WG28 = -0.
V29 = 0.	TS29 = 0.	HS29 = 0.	
FAR41 = 0.01275	FAR51 = 0.01275	FAR56 = 0.01275	
FAR7 = 0.01275	FAR8 = 0.01275	FAR27 = -0.00000	
HV = 17484.7	HV7 = -0.0	HV27 = -0.0	
CV = 0.98500	V9 = 1867.23	V29 = 0.	
FN/HA = 58.188	THG9 = 58.188	THG29 = -0.	
ETAP = 0.	ETATHM = 0.	ETAO = 0.	
SFCU = 0.78114	FG = 6982.5	FN = 6982.5	

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TURBOJET - TWO-SPOOL (WITH A/B)

ALTP = 0.	AV = 0.	VA = 0.	
DELTO = 0.	ETAR = 1.00000	CS = 1116.45	
HPEXT = 0.	LCSL = 0.	HCSL = 0.	
PCBLOH = 0.01000	PCBLOB = 0.	PCBLHZ = 0.	
PCBLC = 0.00750	PCBLT4 = 0.00750	PCBLHP = 0.	PCBLIP = 0.
PROA = 12.000	BPR = 0.	HAENG = 120.00	
PRFT = 1.0000	ETAFT = 1.00000	HA24 = 0.	HA26 = -0.
PRFH = 1.0000	ETA FH = 1.00000	HA21 = 120.000	BLLCSL = 0.
PRLP = 3.0000	ETALP = 0.83000	HA22 = 118.800	BLHCSL = 0.
PRC = 4.0000	ETAC = 0.81000	HA3 = 117.909	
DPD = 0.	UPFH = 0.	DPC = 0.	

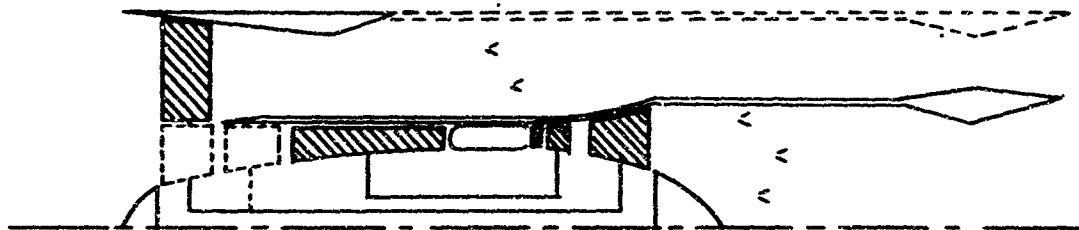
PRESSURES IN LBS/SQ INCH

P1 = 14.696	T1 = 518.67	H1 = 123.92	
P2 = 14.696	T2 = 518.67	H2 = 123.92	
P21H = 14.696	T21 = 518.67	H21 = 123.92	
P21L = 14.696			
P22L = 44.088	T22 = 748.82	H22 = 179.28	BLOW = 1.200
P22 = 44.088			BLOB = 0.
P3 = 176.352	T3 = 1182.02	H3 = 286.64	BLC = 0.891
P4 = 169.298	T4 = 2050.00	H4 = 527.14	WG4 = 119.524
DP6 = 0.0400	ETAS = 0.97000	FAR4 = 0.01370	WF4 = 1.6152
P41 = 169.298	T41 = 2043.98	H41 = 525.37	BLT4 = 0.891
P5 = 64.625	T5 = 1665.89	H5 = 419.45	WG41 = 120.415
PRTH = 2.6197	ETATH = 0.88000	DPT = 0.	
P51 = 64.625	T51 = 1665.89	H51 = 419.45	BLHP = 0.
P55 = 36.074	T55 = 1462.92	H55 = 364.28	WG51 = 120.415
PRTL = 1.7915	ETATL = 0.89000	DPE = 0.02000	
P56 = 36.074	T56 = 1462.92	H56 = 364.28	BLLP = 0.
P6 = 35.352	T6 = 1462.92	H6 = 364.28	WG56 = 120.415
P7 = 31.994	T7 = 3250.00	H7 = 927.36	WG7 = 124.771
* * A/B * *	ETABAB = 0.87000	DPBAB = 0.09500	WF7 = 4.3554
P8 = 31.994	T8 = 3249.99	H8 = 927.36	BLH0Z = 0.
V9 = 2790.61	TS9 = 2751.32	HS9 = 767.01	WG8 = 124.771
P24 = 0.	T24 = 0.	H24 = 0.	
P26 = 0.	T26 = 0.	H26 = 0.	
P27 = 0.	T27 = 0.	H27 = 0.	WG27 = -0.
P28 = 0.	T28 = 0.	H28 = 0.	WG28 = -0.
V29 = 0.	TS29 = 0.	HS29 = 0.	
FAR41 = 0.01360	FAR51 = 0.01360	FAR56 = 0.01360	
FAR7 = 0.05026	FAR8 = 0.05026	FAR27 = -0.00000	
HV = 17446.2	HV7 = 16444.6	HV27 = -0.0	
CV = 0.98500	V9 = 2790.61	V29 = 0.	
FN/HA = 90.183	THG9 = 90.183	THG29 = -0.	
ETAP = 0.	ETATH = 0.	ETA0 = 0.	
SFCU = 1.98617	FG = 10822.0	FN = 10822.0	

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AFAPL-TR-68-88

```
SDATA
$INPUT ALTP=25000.,AH=0.75,DELTO=10.,PRES=14.696,
WAENG=100.,BPR=2.0,CV=0.985,DPD=0.01,
PRFT=2.5,PRC=8.0,ETAFT=0.84,ETAC=0.85,ETATH=0.90,ETATL=0.89,
T4=2100.,DPT=0.0015,DPE=0.015,ETAB=0.985,DPB=0.02,ITITLE=1$
TURBOFAN - AFT-FAN (IE, CF-700 TYPE)
$EUF
```



TURBOFAN - AFT-FAN (IE, CF-700 TYPE)

ALTP = 25000. AM = 0.7500 VA = 771.26
 DELTO = 10.00 ETAR = 1.00000 CS = 1028.35

HPEXT = 0. LCSL = 0. MCSL = 0.
 PCBLON = 0. PCBLOB = 0. PCBLNZ = 0.
 PCBLC = 0. PCBLT4 = 0. PCBLLP = 0.
 PROA = 8.000 BPR = 2.000 WAENG = 100.00

PRFT = 2.5000 ETAFT = 0.84000 WA24 = 66.667 WA26 = 66.667
 PRFH = 1.0000 ETAFH = 1.00000 WA21 = 33.333 BLNCSL = 0.
 PRLP = 1.0000 ETALP = 1.00000 WA22 = 33.333 BLHCSL = 0.
 PRC = 8.0000 ETAC = 0.85000 WA3 = 33.333
 DPD = 0.01000 DPFH = 0. DPC = 0.

PRESSURES IN LBS/SQ INCH

P1 = 5.454 T1 = 439.52 H1 = 104.98
 P2 = 7.921 T2 = 489.18 H2 = 116.86
 P21H = 7.921 T21 = 489.17 H21 = 116.86
 P21L = 7.921
 P22L = 7.921 T22 = 489.17 H22 = 116.86 BLOU = 0.
 P22 = 7.921 BLOB = 0.
 P3 = 63.367 T3 = 951.68 H3 = 228.91 BLC = 0.
 P4 = 62.100 T4 = 2100.00 H4 = 544.02 WG4 = 33.923
 DPB = 0.0200 ETAB = 0.98500 FAR4 = 0.01770 WF4 = 0.5900
 P41 = 62.100 T41 = 2099.99 H41 = 544.02 ELT4 = 0.
 P5 = 24.020 T5 = 1711.48 H5 = 433.92 WG41 = 33.923
 PRTH = 2.5853 ETATH = 0.90000 DPT = 0.00150
 P51 = 23.984 T51 = 1711.48 H51 = 433.92 BLHP = 0.
 P55 = 10.005 T55 = 1411.21 H55 = 351.83 WG51 = 33.923
 PRTL = 2.3973 ETATL = 0.89000 DPE = 0.01500
 P56 = 10.005 T56 = 1411.21 H56 = 351.83 BLLP = 0.
 P6 = 9.855 T6 = 1411.21 H6 = 351.83 WG56 = 33.923
 P7 = 9.855 T7 = 1411.21 H7 = 351.83 WG7 = 33.923
 P8 = 9.855 T8 = 1411.21 H8 = 351.83 BLNOZ = 0.
 V9 = 1606.62 TS9 = 1210.68 HS9 = 298.68 WG8 = 33.923

P24 = 19.802 T24 = 663.35 H24 = 158.63
 P26 = 19.604 T26 = 663.35 H26 = 158.63
 P27 = 19.604 T27 = 663.35 H27 = 158.63 WG27 = 66.667
 P28 = 19.604 T28 = 663.35 H28 = 158.63 WG28 = 66.667
 V29 = 1538.46 TS29 = 460.06 HS29 = 109.90

FAR41 = 0.01770 FAR51 = 0.01770 FAR56 = 0.01770
 FAR7 = 0.01770 FAR8 = 0.01770 FAR27 = 0.
 HV = 17407.3 HV7 = 16444.6 HV27 = -0.0
 CV = 0.98500 V9 = 1606.62 V29 = 1538.46

FM/HA = 24.846 THG9 = 16.940 THG29 = 31.878
 ETAP = 0.66216 ETATH = 0.36181 ETAD = 0.23958
 SFCU = 0.85489 FG = 4881.7 FN = 2484.6

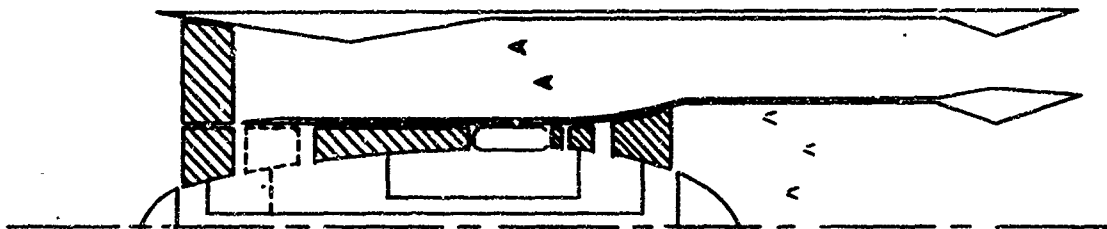
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AFAPL-TR-68-38

SDATA

SINPUT ALTP=60000.,AM=2.6,PRES=14.696,WAENG=800.,BPR=1.7,
CV=0.985,DPD=0.017,DPFH=0.0015,PRFT=2.7,PRFH=2.55,
PRC=3.1,ETAFT=0.86,ETA FH=0.84,ETAC=0.86,ETATH=0.90,ETATL=0.90,
T4=2660.,T27=2960.,DPE=0.02,ETAB=0.985,
ETABFD=0.88,PCBLC=0.055,PCBLT4=0.035,PCBLH=0.02,
DPR=0.02,DPBFD=0.06,ITITLE=1,IDBURN=15
TURBOFAN - DUCT-BURNER

SEQF



TURBOFAN - DUCT-BURNER

ALTP = 60000. An = 2.6000 VA = 2517.00
 DELTO = 0. ETAR = 0.85854 CS = 958.08

HPEXT = 0. LCSL = 0. HCSSL = 0.
 PCBL0W= 0. PCBL0B= 0. PCBLNZ= 0.
 PCBLC = 0.05500 PCBLT4= 0.03500 PCBHP= 0.02000 PCBLLP= 0.00000
 PRUA = 7.893 BPR = 1.700 MAENG = 800.00
 PRFT = 2.7000 ETAFT = 0.86000 WA24 = 503.704 WA26 = 503.704
 PRFH = 2.5500 ETAFH = 0.84000 WA21 = 296.296 BLCSL= 0.
 PRLP = 1.0000 ETALP = 1.00000 WA22 = 295.296 BLHCSSL= 0.
 PRC = 3.1000 ETAC = 0.86000 WA3 = 280.000
 DPD = 0.01700 DPFH = 0.00150 DPC = 0.

PRESSURES IN LBS/SQ INCH

P1 = 1.040	T1 = 389.97	H1 = 93.13	
P2 = 17.806	T2 = 914.09	H2 = 219.63	
P21H = 45.404	T21 = 1231.60	H21 = 299.27	
P21L = 45.336			
P22L = 45.336	T22 = 1231.60	H22 = 299.27	BL0F = 0.
P22 = 45.336			BL0B = 0.
P3 = 140.542	T3 = 1723.64	H3 = 428.84	BLC = 16.296
P4 = 137.731	T4 = 2660.00	H4 = 706.66	LG4 = 284.407
DP3 = 0.0200	ETA3 = 0.98500	FAR4 = 0.01574	DF4 = 4.4067
P41 = 137.731	T41 = 2628.87	H41 = 696.88	BLT4 = 10.370
P5 = 56.659	T5 = 2184.27	H5 = 566.65	WG41 = 294.777
PRTH = 2.4309	ETATH = 0.90000	DPT = 0.	
P51 = 56.659	T51 = 2175.59	H51 = 563.94	BLFP = 5.926
P55 = 7.183	T55 = 1393.33	H55 = 346.10	WG51 = 300.703
PRTL = 7.8877	ETATL = 0.90000	DPE = 0.02000	
P56 = 7.183	T56 = 1393.33	H56 = 346.10	BLLP = 0.000
P6 = 7.040	T6 = 1393.33	H6 = 346.10	WG56 = 300.703
P7 = 7.040	T7 = 1393.33	H7 = 346.10	WG7 = 300.703
P8 = 7.040	T8 = 1393.33	H8 = 346.10	LLNOZ = 0.
V9 = 2640.87	TS9 = 835.55	HS9 = 202.49	WG8 = 300.703
P24 = 48.075	T24 = 1245.51	H24 = 302.83	
P26 = 47.258	T26 = 1245.51	H26 = 302.83	
P27 = 44.422	T27 = 2960.00	H27 = 814.75	WG27 = 520.020
* * D/B * *	ETABFD= 0.88000	DPBFD = 0.06000	DF27 = 16.5167
P28 = 44.422	T28 = 2960.00	H28 = 814.75	WG28 = 520.020
V29 = 4982.69	TS29 = 1214.59	HS29 = 303.55	
FAR41 = 0.01518	FAR51 = 0.01487	FAR56 = 0.01487	
FAR7 = 0.01487	FAR8 = 0.01487	FAR27 = 0.03239	
HV = 16950.8	HV7 = 16444.6	HV27 = 16695.4	
CV = 0.98500	V9 = 2640.87	V29 = 4982.69	

FN/UA = 55.289 THG9 = 30.852 THG29 = 100.667
 ETAP = 0.68561 ETATH = 0.57501 ETA0 = 0.39423
 SFCU = 1.74998 FG = 105215.9 FN = 42631.4

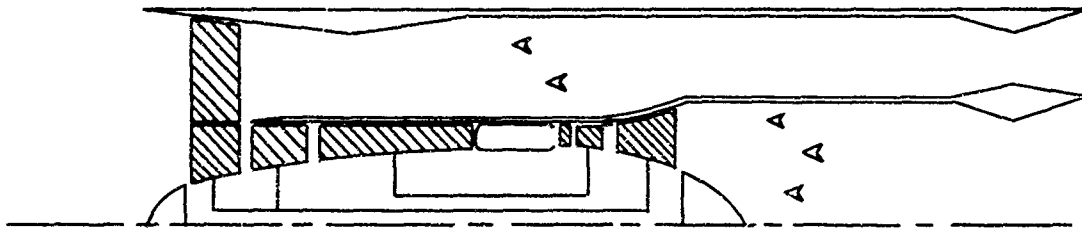
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AFAPL-TR-68-88

SDATA

```
SINPUT ALTP=500.,Am=0.95,PRES=14.696,WAENG=170.,BPR=1.6,  
CV=0.99,OPU=0.03,PRFT=2.2,PRFH=2.1,PRLP=1.7,PKC=3.7,  
ETAFT=0.86,ETA FH=0.84,ETALP=0.87,ETAC=0.86,ETATH=0.90,ETATL=0.91,  
T4=2460.,T7=3200.,T27=3200.,DPE=0.02,  
ETAB=0.98,ETABAB=0.88,ETABFD=0.88,PCBLT4=0.024,PCBLHF=0.015,  
DPB=0.02,DPBAB=0.065,DPBFD=0.08,ITITLE=1,IAFTBN=1,IDRBD=1  
TURBOFAN - A/B AND DUCT-SUPPER
```

SEOF



TURSOFAK - A/B AND DUCT-BURNER

ALTP = 500. AL = 0.9500 VA = 1058.80
 DELTO = 0. ETAR = 1.00000 CS = 1114.53

HPEXT = 0. LCSL = 0. HCSL = 0.
 PCBL0W = 0. PCBL0B = 0. PCBLN2 = 0.
 PCBLC = 0.04000 PCBLT4 = 0.02400 PCBLHP = 0.01500 PC-LLP = 0.90100
 PRDA = 13.209 BPR = 1.600 WAENG = 170.00
 PRFT = 2.2000 ETAFT = 0.86000 WA24 = 104.615 WA26 = 104.615
 PRFH = 2.1000 ETAFH = 0.84000 WA21 = 65.385 WLLCSL = 0.
 PRLP = 1.7000 ETALP = 0.87000 WA22 = 65.385 WLLHCSL = 0.
 PRC = 3.7000 ETAC = 0.86000 WA3 = 62.769
 DPD = 0.03000 DPFH = 0. DPC = 0.

PRESSURES IN LBS/SQ INCH

P1 = 14.432 T1 = 516.89 H1 = 123.49
 P2 = 25.794 T2 = 610.29 H2 = 145.88
 P21H = 54.167 T21 = 780.83 H21 = 187.04
 P21L = 54.167
 P22L = 92.084 T22 = 924.81 H22 = 222.27 BL0B = 0.
 P22 = 92.084 BL0B = 0.
 P3 = 340.710 T3 = 1382.96 H3 = 338.34 BLC = 2.615
 P4 = 333.856 T4 = 2460.00 H4 = 649.06 PG4 = 63.876
 DPB = 0.0200 ETAB = 0.98000 FAR4 = 0.01764 HF4 = 1.1069
 P41 = 333.896 T41 = 2435.95 H41 = 641.61 BLT4 = 1.569
 P5 = 142.646 T5 = 2037.14 H5 = 525.65 HG41 = 65.445
 PRTH = 2.3407 ETATH = 0.90000 DPT = 0.
 P51 = 142.646 T51 = 2028.04 H51 = 522.88 BLHP = 0.981
 P55 = 38.075 T55 = 1516.21 H55 = 379.92 HG51 = 66.426
 PRTL = 3.7465 ETATL = 0.91000 DPE = 0.02000
 P56 = 38.075 T56 = 1516.08 H56 = 379.88 BLLP = 0.065
 P6 = 37.313 T6 = 1516.08 H6 = 379.88 HG56 = 66.492
 P7 = 34.888 T7 = 3200.00 H7 = 912.39 HG7 = 68.741
 * * A/B * * ETABAB = 0.88000 DPBAB = 0.06500 HF7 = 2.2495
 P8 = 34.888 T8 = 3199.99 H8 = 912.39 BLMOZ = 0.
 V9 = 2948.11 TS9 = 2647.98 HS9 = 735.23 HGR = 68.741
 P24 = 56.746 T24 = 788.47 H24 = 188.90
 P25 = 55.044 T26 = 788.47 H26 = 188.90
 P27 = 50.640 T27 = 3200.00 H27 = 905.53 HG27 = 109.376
 * * D/B * * ETABFD = 0.88000 DPBFD = 0.08000 HF27 = 4.7611
 P28 = 50.640 T28 = 3200.00 H28 = 905.53 HG28 = 109.376
 V29 = 3444.72 TS29 = 2434.50 HS29 = 663.66
 FAR41 = 0.01720 FAR51 = 0.01695 FAR56 = 0.01693
 FAR7 = 0.05133 FAR8 = 0.05133 FAR27 = 0.04551
 HV = 17117.6 HV7 = 16488.1 HV27 = 16488.1
 CV = 0.99000 V9 = 2948.11 V29 = 3444.72

FR/PA = 73.028 THG9 = 37.052 THG29 = 68.885
 ETAP = 0.49353 ETATH = 0.25138 ETAU = 0.12407
 SFCU = 2.35391 FG = 18009.2 FH = 12414.7

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13. ABSTRACT This report describes a digital computer program titled CARPET. CARPET is a computer program that calculates parametric turbojet/turbofan engine performance. It can also analyze the performance of a specific engine. The program is written in Fortran IV language and was designed for use on an IBM 7090 Digital Computer. Included in the report are listings of the complete program, various sample input data and the corresponding output.			

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